Illinois U Library
University of Illinois Library
Undergraduate Division
Navy Pier
Chicago, Ill.
Attn: L. W. Anderson
2 copies

ILLINOIS TECHNOGRAPH

MARCH, 1956 .25

James Chisholm, class of '41,
speaks from experience when he says,

"Men with ability and ambition really have a chance to get ahead at U.S. Steel"

• A responsible position can come quickly to those graduate engineers at U.S. Steel who show ability and ambition. Management training programs are designed to stimulate and develop these qualities as the trainee "learns by doing." His training is always a fascinating challenge and he works with the best equipment and the finest people in the business.

James Chisholm is typical of the young men who rapidly rise to an important position at U.S. Steel. Jim came to U.S. Steel as a trainee in 1941 after graduating as an M.E. Shortly thereafter he entered military service for four years. Upon his return to U.S. Steel in 1946, he advanced steadily until, in 1951, he was appointed to his present position as Assistant Superintendent of Blast Furnaces at the new Fairless Works at Morrisville, Pa.

Jim is now in charge of quality control for open hearth furnaces at Fairless, the unloading of all ore ships and the operation of the plant's two big blast furnaces—each with a rated output of 1500 tons per day.

Jim feels that the opportunities for graduate engineers are exceptional at U.S. Steel. He remarked that in his own department alone, six college trainees have been put into management positions within the last couple of years. He says that chances for advancement are even better now with the current expansion of facilities and the development of new products and markets.

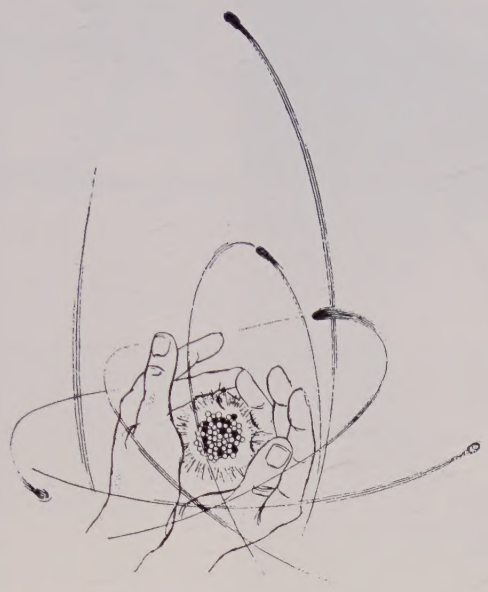
If *you* are interested in a challenging and rewarding career with United States Steel, and feel that you can qualify, you can get details from your college placement director. And we will gladly send you a copy of our informative booklet, "Paths of Opportunity," which describes U.S. Steel and the openings in various scientific fields. Just write to United States Steel Corporation, Personnel Division, Room 1622, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

USS

UNITED STATES STEEL

AMERICAN BRIDGE . . AMERICAN STEEL & WIRE and CYCLONE FENCE . . COLUMBIA-GENEVA STEEL . . CONSOLIDATED WESTERN STEEL . . GERRARD STEEL STRAPPING . . NATIONAL TUBE
OIL WELL SUPPLY . . TENNESSEE COAL & IRON . . UNITED STATES STEEL PRODUCTS . . UNITED STATES STEEL SUPPLY . . *Divisions of* UNITED STATES STEEL CORPORATION, PITTSBURGH
UNITED STATES STEEL HOMES, INC. • UNION SUPPLY COMPANY • UNITED STATES STEEL EXPORT COMPANY • UNIVERSAL ATLAS CEMENT COMPANY 5-690



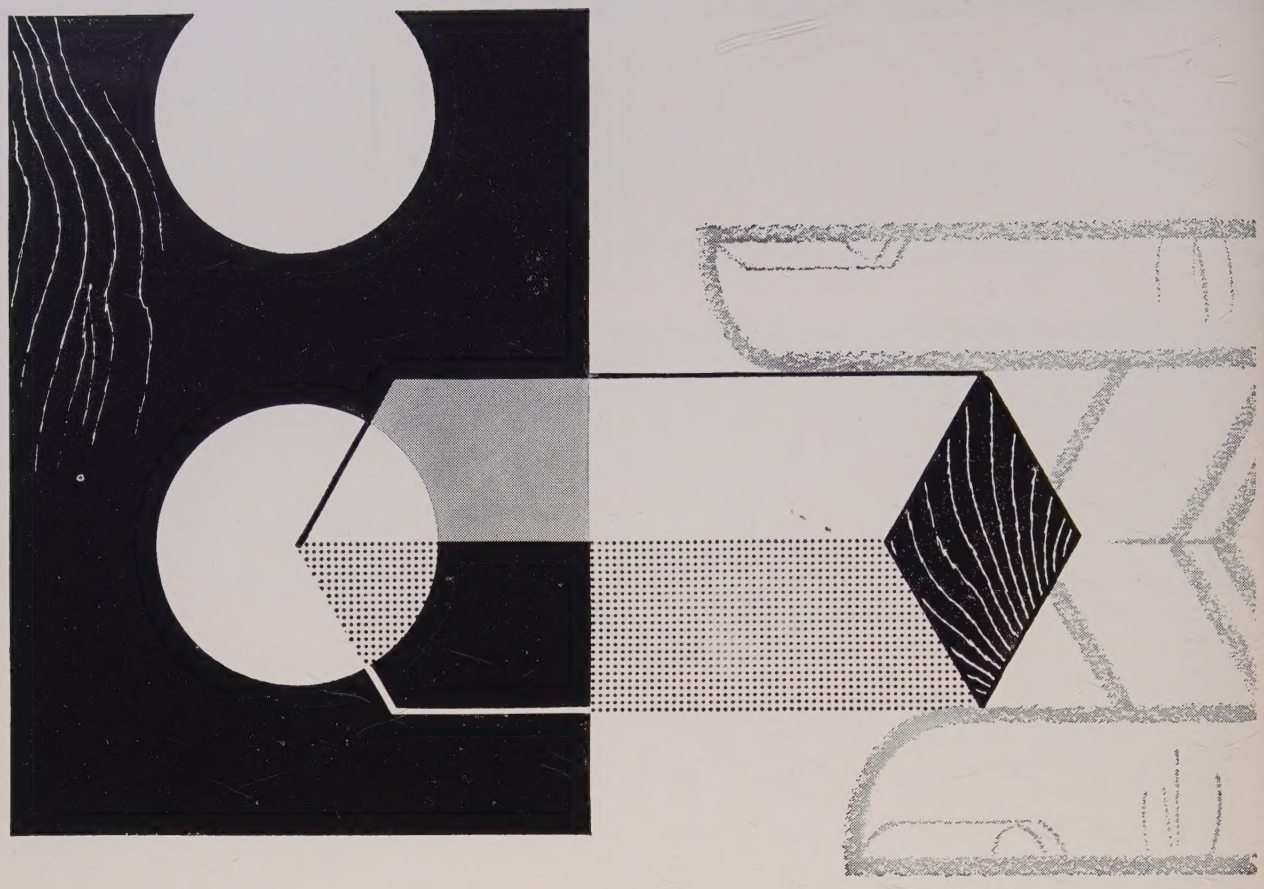
The Year XI . . .

It is eleven years since the year of the Bomb. It was then that the world was awakened to the realization that the mind of man had entered the nucleus of the atom and had learned to control it. The eternal paradox of man's work was not absent and the mushroom clouds turned, in turn, to control man with a bond of fear.

The names of the men who made the work of that year possible are legion and it is extremely doubtful that they would have applauded the initial use of their contributions. But it would seem that with the passage of years there has been a return to sanity and with last year's proposal by President Eisenhower and the favorable conferences at Geneva a sort of adolescent stature has been achieved with our relatio nwith the atom. This then, is the year XI and the years that follow it can either lead to the maturity of peace or the insanity of destruction.

Last year at this time one of the greatest contributers to the control of the atom died: Albert Einstein. This issue is dedicated to his memory with the hope that the spirit that guided his life will guide man in the use of his accomplishments.

—P.E.L.



How about **SQUARE PEGS** *and* **ROUND HOLES?**

EVERY on-his-toes engineering senior knows that his first job is a most important one.

Naturally, he wants a job where he fits in with his work, his company, the men around him. Because that's where his chances are best for building a lifetime career.

He surely doesn't want to be a square peg in a round hole.

To such a young man we can say in all honesty that — here at General Motors — he has a unique opportunity to "fit in."

For here is a company with abundant opportunities for many different kinds of men, many varieties of talent, many fields of interest.

—A company where engineering opportunities exist in the design and manufacturing of cars, trucks, home appliances, aircraft engines, Diesel engines, road-building equipment, defense weapons.

—A company whose vigorous decentralization results in small, close-knit technical teams enjoying harmonious working conditions and highest mutual respect.

—An organization that bends every effort to encourage professional advancement through training programs, publication of papers, and the support of vast facilities and resources.

We'll be glad to help you find where you might fit in. Let your Placement Officer arrange it, or write us directly.

GM Positions Now Available In These Fields:

MECHANICAL ENGINEERING
CHEMICAL ENGINEERING
ELECTRICAL ENGINEERING
INDUSTRIAL ENGINEERING
METALLURGICAL ENGINEERING
AERONAUTICAL ENGINEERING
BUSINESS ADMINISTRATION

GENERAL MOTORS

Personnel Staff, Detroit 2, Michigan

Editorial Staff

Editor
Paul E. LaViolette

Associate Editor
Harry Hirsch

Make-up Editor
Glenn Andrews

Photo Editors
David L. Komyathy
Jack Siebert

Assistants
Edwin Snow
Dorothy Hazel
Donald Georgi
John Brennan
Paul Davis
James Kries
Jon Grushka
Frank Hunyady
Phil Philhower

•

Business Staff

Business Manager
Larry Kiefling

Circulation Director
Ronald Fox

Assistants
Ronald Wendt
Roger Harrison

•

Faculty Advisers

R. W. Bohl
P. K. Hudson
O. Livermore

MEMBERS OF ENGINEERING COLLEGE MAGAZINES ASSOCIATED
Chairman: Prof. Mark Hobson
University of Nebraska, Lincoln Neb.
Vice-Chairman: Prof. R. W. Bohl
University of Illinois, Urbana, Ill.

Arkansas Engineer, Cincinnati Cooperative Engineer, City College Vector, Colorado Engineer, Cornell Engineer, Denver Engineer, Drexel Technical Journal, Georgia Tech Engineer, Illinois Technograph, Iowa Engineer, Iowa Transit, Kansas Engineer, Kansas State Engineer, Kentucky Engineer, Louisiana State University Engineer, Louisiana Tech Engineer, Manhattan Engineer, Marquette Engineer, Michigan Technic, Minnesota Technolog, Missouri Shamrock, Nebraska Blueprint, New York University Quadrangle, North Dakota Engineer, Northwestern Engineer, Notre Dame Technical Review, Ohio State Engineer, Oklahoma State Engineer, Oregon State Technical Record, Penn State Engineer, Pennsylvania Triangle, Purdue Engineer, RPI Engineer, Rochester Indicator, SC Engineer, Rose Technic, Southern Enginerer, Spartan Engineer, Wayne Engineer, and Wisconsin Engineer.

Published eight times during the year (October, November, December, January, February, March, April and May) by the Illini Publishing Company. Entered as second class matter, October 30, 1920, at the post office at Urbana, Illinois, under the Act of March 3, 1879. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions $1.50 per year. Single copy 25 cents. Reprint rights reserved by *The Illinois Technograph.* Publisher's Representative—Littell Murray-Barnhill, 605 North Michigan Avenue, Chicago 11, Ill. 101 Park Avenue, New York 17, New York.

THE ILLINOIS TECHNOGRAPH

Volume 71 **Number 6**

Contents:

Editorial ---------- 5
Albert Einstein (1879-1955) ---------- 11
The Life of Albert Einstein ---------- 15
High Fidelity ---------- 22
Little Blue Rotameter ---------- 27
Women Are for Engineering ---------- 30
Tomorrow's Highways ---------- 33
Technocutie ---------- 39
Sliderule Slippers ---------- 44
Unified Curriculum ---------- 49
Skimming ---------- 52
Book Review ---------- 58
Early Experimenters ---------- 66
Brain Teasers ---------- 72
To An Engineer's Sweetheart ---------- 76
Technocracks ---------- 80

Our Cover

This library, containing bottles instead of books, was founded in 1940 when Rohm & Haas—to whom we are indebted for our cover plates—placed on its shelves Amberlite IR-1, the first commercial resinous exchanger. Like many of the resins shown here, Amberlite IR-1 is already antiquated, for obsolescence is characteristic of any rapidly advancing science.

ALBERT EINSTEIN

1879-1955

Tributes by Niels Bohr and I. I. Rabi

With the death of Albert Einstein, a life in the service of science and humanity which was as rich and fruitful as any in the whole history of our culture has come to an end. Mankind will always be indebted to Einstein for the removal of the obstacles to our outlook which were involved in the primitive notions of absolute space and time. He gave us a world picture with a unity and harmony surpassing the boldest dreams of the past.

Einstein's genius, characterized equally by logical clarity and creative imagination, succeeded in remolding and widening the imposing edifice whose foundations had been laid by Newton's great work. Within the frame of the relativity theory, demanding a formulation of the laws of nature independent of the observer and emphasizing the singular role of the speed of light, gravitational effects lost their isolated position and appeared as an integral part of a general kinematic description, capable of verification by refined astronomical observations. Moreover, Einstein's recognition of the equivalence of mass and energy should prove an invaluable guide in the exploration of atomic phenomena.

Indeed, the breadth of Einstein's views and openness of his mind found most remarkable expression in the fact that, in the very same years when he gave a widened outlook to classical physics, he thoroughly grasped the fact that Planck's discovery of the universal quantum of action revealed an inherent limitation in such an approach. With unfailing intuition Einstein was led to the introduction of the idea of the photon as the carrier of momentum and energy in individual radiative processes. He thereby provided the starting point for the establishment of consistent quantum theoretical methods which have made it possible to account for an immense amount of experimental evidence concering the properties of matter and even demanded reconsideration of our most elementary concepts.

The same spirit that characterized Einstein's unique scientific achievements also marked his attitude in all human relations. Notwithstanding the increasing reverence which people everywhere felt for his attainments and character, he behaved with unchanging natural modesty and expressed himself with a subtle and charming humor. He was always pared to help people in difficulties of any kind, and to him, who himself had experienced the evils of racial prejudice, the promotion of understanding among nations was a foremost endeavor. His earnest admonitions on the responsibility involved in our rapidly growing mastery of the forces of nature will surely help to meet the challenge to civilization in the proper spirit.

To the whole of mankind Albert Einstein's death is a great loss, and to those of us who had the good fortune to enjoy his warm friendship it is a grief that we shall never more be able to see his gentle smile and listen to him. But the memories he has left behind will remain an ever-living source of fortitude and encouragement. —NIELS BOHR

* * * *

With Albert Einstein's death a great light has gone out in the world of physics, for Einstein, more than any other man, set the tone of the physics of the 20th century. His theories of special and general relativity were the capstone of classical physics and the theory of fields. His theory of light quanta and his later demonstration of the nature of the fluctuations of "black body" radiation raised the paradox of the wave-particle duality, which was partly resolved two decades later in the principle of complementarity of Neils Bohr and Werner Heisenberg. His 1917 paper, introducing the ideas of spontaneous and stimulated emission of radiation, was the first clear statement of the statistical nature of fundamental atomic phenomena. The famous Einstein A and B coefficients led to the quantitative use of the correspondence principle and to the formulation of the Kramers-Heisenberg dispersion formual, which in turn led to Heisenberg's matrix mechanics. Einstein was therefore in a very real sense the founder of the statistical theory of fundamental atomic phenomena.

There is scarcely any important fundamental idea in modern physics whose origin does not trace back at least in part to Einstein. Yet, like many another father, he was not really satisfied with the

FRONTISPIECE: The young Einstein posed for the photograph on the opposite page in 1905. He was 26 and a clerk in the Swiss patent office. This was the year of his greatest productivity. In 1905 he made a great contribution to the quantum theory and published a paper entitled *"On the Electrodynamics of Moving Bodies."* This paper set forth the special theory of relativity. (Photo reprinted with permission from *Scientific American,* Vol. 192, No. 6, June, 1955.)

children of his scientific imagination. He never regarded his mighty contributions to quantum theory as other than provisional suggestions for the ordering of phenomena. The subsequent formulation of quantum mechanics and especially the thoroughgoing statistical interpretations were to him philosophically and esthetically repugnant.

The Einstein-Bose statistics and the Einstein condensation phenomenon were his last important positive contributions to quantum theory. His subsequent role with respect to quantum theory was that of a critic. He applied the force of his great imagination to the construction of imaginary experiments which involved the theory in seemingly paradoxical and contradictory predictions. The resolution of these paradoxes, chiefly through the efforts of Bohr, served to refine and clarify the principle of complimentarity but left Einstein unconvinced.

His real love was the theory of fields, which he pursued with unremitting vigor to the very end of his more than 50 years of active scientific life. This preoccupation is to a large degree the key to his scientific personality. The theory of general relativity was constructed on the basis of a physical observation of the equivalence of inertial and gravitational mass under certain simple circumstances. Beyond that, his guiding principles were his esthetic and philosophical urge for simplicity and symmetry. His intuition and taste led him to believe that the equivalence principle was true in general, and that the equations of physics must be covariant in all systems of coordinates. With these guidelines and with the use of mathematical tools already at hand, he built a theory of gravitation and of the structure of the cosmos.

Like a mystic who has had a divine illumination, Einstein in his search for the ideal could be satisfied with nothing less than a theory which would encompass all phenomena—atomic and cosmic. He once remarked to me in a discussion concerning the newly discovered meson: "We already know that the electron is quantized in charge and mass. Should not this be enough empirical information for a theory of matter?" It was a goal of this grandeur that drove him in his search for a unified field theory.

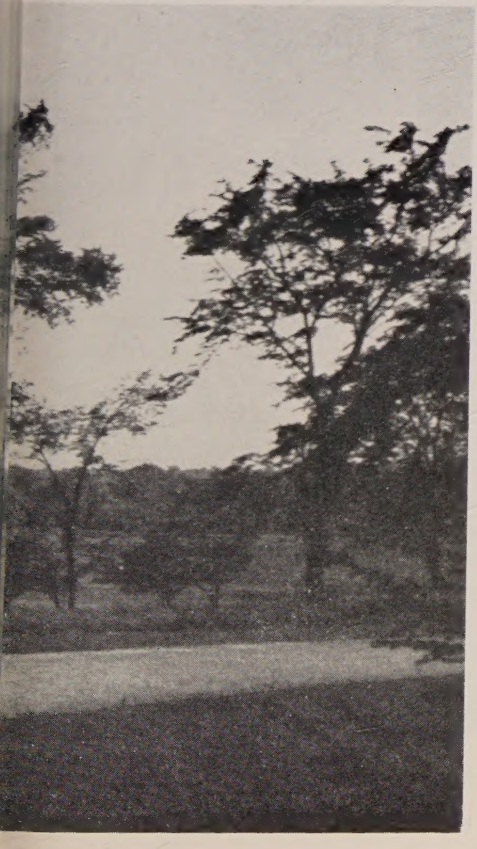
Einstein was a unique personality. He was not attracted by fame or fortune nor swayed by the opinions of the majority. Ke knew his talent and guarded it jealously against outside interference. Although fearless in support of any cause he considered worthy, he have only so much of himself and no more. Physics was his life, and he lived it according to his own lights, with complete objectivity and integrity.

He was the prince of physicists, and the imprint of his mighty strides will give direction to his beloved science for generations to come. —I. I. RABI

Reprinted with permission from *Scientific American,* June 1955, Vol. 192, No. 6

THE WORLDS OF ALBERT EINSTEIN

Above: The scope of Einstein's studies—the universe



Left: The Institute of Advanced Study, at which Einstein was professor of mathematics

Einstein's home at 112 Mercer Street in Princeton, N.J.

The Life of Albert Einstein

by Glenn Andrews, E.E. '57

"My life is a simple thing that would interest no one."

These were the words Albert Einstein gave reporters when he first reached these shores. In truth, his life was a simple one, but out of this simplicity grew profound ideas that set in motion a reappraisal of every postulate and premise of modern natural science. His tools were the simplest possible: a pen or pencil and a scratch pad.

Albert Einstein was born on March 14, 1879, at Ulm, a middle sized city in the Swabian part of Bavaria in Southwestern Germany. A year after his birth, the family moved to Munich, the political and intellectual center of southern Germany. His father, Hermann Einstein, was an optimistic person who enjoyed life. Although he was not a particularly good businessman, he had a small electrochemical factory that he operated with the aid of his brother. When his work was done each day he enjoyed taking his family on outings into the beautiful country around Munich. Albert was raised with a love of the beauty of nature and always retained a certain attachment for his homeland and its people.

There can be little doubt that this origin in a semi-rural community was of great significance for Albert Einstein's entire psychological development. The Swabians are practical in daily life, and participate joyfully in every kind of art and pleasure as well as in philosophical and religious speculation, but are averse to any kind of mechanical order.

Little Albert was certainly no prodigy. In fact, it was quite a long time before he learned to speak and when he did he was always taciturn and did not choose to enter into games that the other children played. From the very beginning he separated himself from other children of his own age and engaged in daydreaming and meditation.

Although Einstein's parents were Jewish, they were not sufficiently interested in a Jewish education to send their children to a Jewish school since there was none in Munich and it would have been expensive. Munich was for the most part Catholic and Albert attended the Catholic elementary school where he was the only Jew in his class. There was no feeling of unpleasantness in the situation, but only a slight strangeness in the different religious traditions.

On the whole Albert saw little difference between school and his conception of the Prussian Army—that is, an organization that subjected a mechanical pressure on the individual and prevented a freedom of activity by placing the main emphasis on obedience and discipline.

As he grew, his interest in science was further aroused by his reading of the popular scientific books—such books as Bernstein's *Popular Books on Natural Science* and Buchner's *Force and Matter*. Einstein's interest in mathematics was also aroused at home rather than at school. It was his uncle who was in partnership with his father that first introduced Einstein to the elements of algebra. He was most impressed by a book he obtained at the age of twelve on Euclid's Geometry. The clarity of the exposition and proof given for every statement made him unable to put the book down until he had finished it. Suddenly the world with its disorder and uncleanliness seemed to contain an element of order and beauty. He retained this love of the beautiful and orderly throughout his life and has made numerous applications of it.

When Einstein was fifteen his father left Munich to seek a business elsewhere. His pleasure loving temperament led him to choose the happy country of Italy and he settled down in the city of Milan in an enterprise similar to the one he had in Munich. Albert, however, did not follow his father to Italy. Every middle class German of the day that desired a position in one of the intellectual professions had to pursue a course of study at the University. In order to be entitled to become a student at the University, Einstein had to have a diploma from the gymnasium he was attending. So he stayed behind in Munich to finish his schooling.

In mathematics Einstein was far ahead of the rest of his classmates, but in the classical languages he felt little or no interest. He was miserable at having to occupy himself with subjects in which he had to learn merely because he had an examination in them.

After spending several months suffering in solitude Einstein made plans to leave the school. He obtained a certificate from a physician stating that because of a nervous breakdown, it was necessary for him to leave school for a period in order to recuperate. He also obtained a statement from his mathematics teacher affirming his extraordinary knowledge of mathematics which qualified him for admission to an advanced institute for the study of mathematics. When he gained his release he joined his parents in Milan.

Einstein enjoyed the beautiful country around Milan and observed with delight the simple, easy way of the Italians who seemed to be in accord with the laws of nature and lived within their natural impulses.

However he now had to choose a life profession. With his interest in the pure sciences and of mathematics and physics, it was natural that he should choose the technological sciences for further study. Furthermore, he believed that since he had no diploma from the gymnasium but had an excellent knowledge of mathematics, he would have an easier time entering a technical institution rather than a regular university.

The most advanced technical school in Central Europe outside of Germany was the Zurich Polytechnicum in Switzerland and Einstein chose this for his advanced study. However, because of his lack of knowledge in the languages and the descriptive natural sciences of zoology and botany, he failed the entrance examinations. Miserable because of his failure at Zurich, he obtained entrance to the lesser cantonal school in the small Swiss city of Aarau.

Along this street Einstein walked to the Institute of Advanced Study. This picture and the picture on pp. 13 and 14 reprinted with permission of Scientific American, Vol. 193, No. 1, July, 1955.)

However he was pleasantly surprised because Aarau, while not as great as Zurich, taught their students to think and work independently. Here he lost his aversion to school and became more friendly with his fellow classmates with the result that after a year he obtained his diploma and was thereupon admitted to the Zurich Polytechnicum without further examination. At Zurich he pursued his chief interest of physics and completed his studies at the turn of the 19th century.

After graduation Einstein sought to teach in the colleges or the secondary schools of Switzerland. But because he was Jewish and because he was not a native of Switzerland, he was unable to get a position as instructor and was forced to accept a job in the patent office at Bern. However, this position was by no means uninteresting and enabled Einstein to study thoroughly the many new ideas that passed through the office. Furthermore, he had more time to himself and he devoted it to the development of special theories he had started while at Zurich.

Soon after his arrival in Bern, Einstein married Mileva Maritsch, his fellow student at the Polytechnicum and Einstein settled down to a family life. Two sons were born to him and he experienced the pleasure of living his own life with his family.

In this pleasurable atmosphere Einstein plunged into the formulation and research of the theory of relativity and in 1905, he published his jottings in five papers. In the fifth of these lay the nucleii of the atomic age. Because of the revolutionary ideas presented in these papers the great men of physics became interested in his work, and the true genius evolved slowly in the scientific world. He was invited to Berlin to become a professor at the University of Berlin and to engage in research at the newly founded Kaiser Wilhelm Institute of Research. At this time he was just 34 years old and was a young man among many who were in general much older and with proud pasts and great authority.

At this time Einstein found his married life rather strained and he was separated from his wife Maleva. Sadly he went back to a bachelor life. Later on he married his cousin, Elsa Einstein.

Since earliest childhood, Albert and Elsa had been attached to each other. They had played together in the home of Albert's parents in Munich and had, at the same time, had their first artistic experience at the Munich Opera. A mature woman, she rejoined him, a mature man, at the height of his scientific work, which was no longer a matter of search and stumbling, but a path with fixed direction and definite scope.

It was not long before the World War broke out. Even though his health was poor and many psychological conditions affected the people in Germany at the time, this did not prevent Einstein from devoting himself with the greatest intensity to improving his special theory of gravitation.

This was a time when political ideals had been shattered by the war and new philosophies and political systems were being sought. The world was puzzled and mysteriously attracted by the connection between Einstein's scientific work and politics and the public interest was further increased by the appearance of articles in daily newspapers stating that Einstein's theories might be of some importance in physics, but were certainly untrue philosophically. The world wanted to see and hear Einstein and he received invitations to give lectures from many countries. He was glad to leave Berlin and Germany and go away from this tormenting atmosphere, and to see new countries.

At the University of Leiden in Holland, he lectured on the "Ether and the Relativity Theory." This lecture gave rise to much controversy because of the strong belief in the existence of ether as the medium that carried light. He was appointed professor of the university and lectured there for a whole year. He then traveled to Czechoslovakia where he lectured at Prague and in the early 1920's went to Vienna to lecture some time before returning to Berlin.

By now the name Einstein became a name for anyone who writes something incomprehensible to the general public and is admired on this account. The word "relative" stimulated people to the most trivial jokes. Einstein paid as little attention as possible to all the political and personal vexation and endeavored rather to dispel scientific and philosophical misunderstandings of his theories. While he was working to dispel these formulations, other thoughts were running through his head. He had received an invitation to accompany Weizmann, the leader of the Zionist movement, on a trip to the United States. The purpose of the trip was to obtain American help in the establishing of a Jewish national home in Palestine and in particular for the Hebrew University to be founded there. Einstein was now in a position to place his prestige at the disposal of the Zionist movement for these purposes, which he considered a great educational significance for the Jews.

He was motivated in his acceptance of the invitation chiefly by the desire not only to be active as a pure scientist but also to contribute something to the welfare of persecuted human beings. He was also impelled by the desire to see America with his own eyes and to become acquainted with the life in this new world. He felt it would be worthwhile for him to know something of this great country on the other side of the Atlantic whose tradition of democracy and tolerance had always struck a sympathetic chord with him.

America greeted the scientist with great enthusiasm and reporters were on hand in droves to obtain from Einstein

a few statements concerning his recent theories and the speculation they caused. One of the questions put to Einstein was to explain the existence of such mass enthusiasm for an abstract theory that is so hard to understand. He jokingly replied that this was a problem for psychopathological investigation but when asked if it might be due to the circumstance that his theory has something to do with the universe and the universe in turn with religion, he said it was quite possible, but to dispel any exaggerated opinions regarding the general significance of his theory, he quickly added, "It will not change the concept of the man in the street." The only significance of the theory, he said, was that it derived from simple principles certain natural phenomena that were formerly derived from complicated principles and that this is naturally important for philosophers, but hardly for the man in the street. After a rather short stay in which he helped further the Jewish cause in America, he returned to his duties at the Kaiser Wilhelm Institute in Berlin, but made frequent trips to America in the future to give lectures.

In the 1930's while Hitler was rising to power in Germany, the Jews were being persecuted by the Hitler regime and prevented from working for the German state. Einstein's possessions, his villa as well as his bank account, were confiscated by the state. His writings on the relativity theory were burned publicly in the square before the State Opera House in Berlin, together with other of his books, some of which were regarded as obscene, others as Bolshevistic.

In 1933, Einstein sailed for America, yet it was interesting to note the remarkable manner in which Einstein's abstract theories were utilized by political and religious groups in Europe for their purposes.

The second World War came and work on the atomic bomb was speeded up. It was brought to a dramatic and terrible end by the atomic bomb and again Einstein's name was brought to public attention. The result that he had derived from his special theory of relativity in 1905—namely that mass and energy are equivalent—was demonstrated to the world with almost incredible force of destruction.

His work, at the Institute for Advanced Study in Princeton, where he did most of his work in the United States, continued and further investigation of the energy principle produced the hydrogen bomb, which was much more devastating than the atomic bomb.

Einstein is no longer with us but his ideas will remain with us forever. Yet for all his scientific wisdom, he was innocent of the world around him. He had a certain helplessness in the face of everyday problems. He was easily presumed upon. He once agreed to buy an elevator for his two-story house because "The man who came to interest me in it—I liked him so much, I could not say no." He loved humanity, but was comfortable with few of its members. In politics, he took sides that were unpopular with the Americans. In the sphere of religion his views contradicted strongly held beliefs. He was, however, regarded as one of the most unselfish men of his time. His sad and wizened face, with its disordered halo of white hair and its soulful brown eyes, belied his genius. President Eisenhower has said that no other man has contributed so much to the expansion of 20th century knowledge. Einstein came close to proving by mathematical logic what men of religion had long accepted on philosophical reasoning, or faith, that the laws which move the tiniest unseen electrons must also govern the macrocosms of the space around us.

Last April, Einstein's fourth dimension, time, overtook him. He died in his sleep of a ruptured artery. The world might well reflect upon the true genius of a man who became the most profound thinker and scientist of our time.

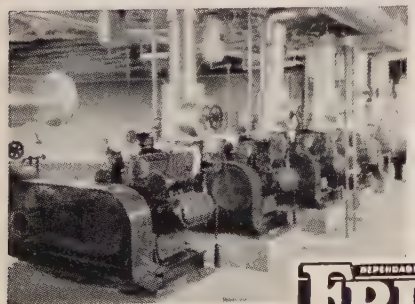
Another Great Underground Storage Cooled with FRICK Refrigeration

The Inland Cold Storage, Inc., at Kansas City, is remarkable in many ways.

Here over a hundred acres of dry space in a former limestone quarry are available. Three million cubic feet are already refrigerated. Quick-freezing capacity is 60,000 lb. per day; freezer storages hold 1200 carloads, and fresh-produce rooms another 300 carloads.

Five Frick "ECLIPSE" ammonia compressors and 40 Frick air cooling units, among other equipment, supply refrigeration to the huge rooms through the medium of cold brine.

Get data now on the Frick Graduate Training Course in Refrigeration.



Frick "ECLIPSE" compressors

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.

Engineers & Physicists

Inquiries are invited regarding openings on our Staff in the fields listed below:

Scientific Staff Relations

Hughes
RESEARCH AND DEVELOPMENT LABORATORIES

- Ground and Airborne Radar
- Fire Control Systems
- Guided Missile Systems
- Airborne Digital Computers
- Miniaturization and Advanced Packaging
- Communication Systems
- Microwave Ferrite Devices
- Antennas and Radomes
- Indicator and Microwave Tubes
- Semiconductor Devices

Culver City, Los Angeles County, California

Relocation of applicant must not cause disruption of an urgent military project.

A FEW YEARS AGO, HE WAS ON CAMPUS AT PURDUE UNIVERSITY, AND NOW . . .

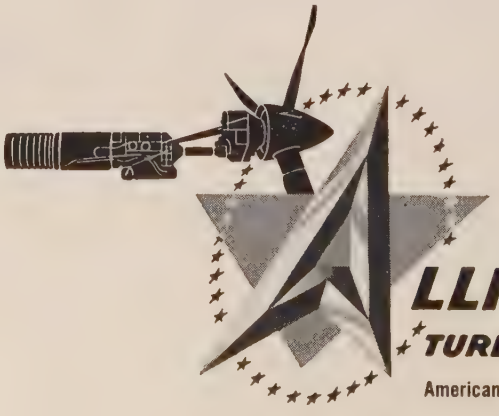
FLOYD D. (Doug) WALLACE, JR., above, is a senior project engineer at Allison.

He left Purdue in 1947 with his AE degree and came to Allison the same year. Presently, he is in charge of instrumentation and automatic process controls at Allison's new Research & Development test center.

With Allison now in the midst of a $75 million engineering expansion and building program, much of his time is spent in vendor contact work, studying and selecting equipment most adequate to do the job; observing, and helping with installation. He is shown above checking a control valve positioning amplifier on the instrument panel for controlling air pressures and temperatures of four electric motor-driven, axial flow compressors. This new facility is part of the new Research and Development test center, which—when completed—will enable testing of individual combustion components for turbo-prop and turbo-jet engines, compressor and turbine components.

Doug's work is "cut out" for him for some time to come, for only recently, Allison broke ground for the engineering building which is to be the center of expanded Research and Development facilities for advanced types of aircraft engines for commercial and military use.

With this long-range expansion program, Allison needs more engineering personnel, and opportunity for young graduate engineers is unlimited. Arrange now for an early interview with our representative on your campus, or write for information about the possibilities of YOUR engineering career at Allison: Personnel Dept., Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.



ALLISON

TURBO-PROP ENGINES

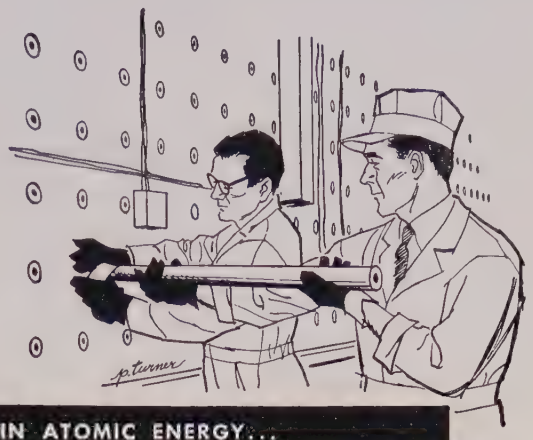
American built for the new era in air travel

College graduates develop their skills...

growing with UNION CARBIDE

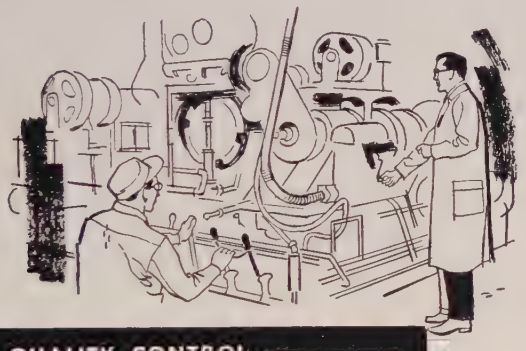
IN TITANIUM RESEARCH...

"After graduating in 1951 with an M.S. in metallurgical engineering, I joined the Metals Research Laboratories of Electro Metallurgical Company. Some of my research in corrosion behavior and notch sensitivity resulted in a patent for a stainless steel. In 1954 I was promoted to Section Leader, supervising research projects in titanium and other reactive metals."



IN ATOMIC ENERGY...

"I graduated in '51 with a B.S. in physics and mathematics. Because of my interest in atomic energy I joined Union Carbide Nuclear Company at Oak Ridge in April, 1954. By November of that year I was classified as a Junior Physicist. I now supervise the operation of mass spectrometers used to analyze radioisotopes produced in atomic reactors here at Oak Ridge."



IN QUALITY CONTROL...

"I'm an electrical engineer, Class of '51. I started in Works Engineering at a National Carbon Company plant. A year later I transferred to a location where Works Engineering covered three plants, and soon became Engineer on important development projects. I was recently promoted to Assistant Head of the Product and Process Control Laboratory at one of the plants."

IN METALLURGICAL CONTROL...

"I'm a metallurgical engineer, Class of '49. I started at Haynes Stellite Company as a Development Engineer in high-temperature alloys, and in 1953 became Shift Foreman in the Metallurgical Control Department. Recently I was promoted to General Foreman, responsible for the Chemical, Spectographic, Material Release, and X-Ray Departments and the Test Laboratory."

THEY ARE KEY MEN WITH A FUTURE...

If you are interested in a future in production, development, research, engineering, or technical sales, check the opportunities with any Division of Union Carbide. Get in touch with your college placement officer, or write directly to:

UCC DIVISIONS INCLUDE...

- Bakelite Company • Carbide and Carbon Chemicals Company
- Electro Metallurgical Company • Haynes Stellite Company
- Linde Air Products Company • National Carbon Company
- Silicones Division • Union Carbide Nuclear Company

UNION CARBIDE

AND CARBON CORPORATION

UCC

Industrial Relations Department, Room 406
30 East 42nd Street, New York 17, N. Y.

High Fidelity . . .

by Fredric Rosenbaum, E.E. '59

In recent years a great furor has arisen in the field of audio technology. Responsible for this furor is that indefinitive phrase "high-fidelity."

High fidelity concerns itself with the faithful electronic reproduction of sound. To the serious music lover, high fidelity, or "hi-fi," is a means of experiencing the performance of his favorite artist right in his own living room with a degree of realism and presence which was heretofore possible only in a concert hall. Realism and presence are the keys to high fidelity sound reproduction.

There are three basic characteristics which provide realism and presence in a high fidelity mysic system. The first of these is lack of distortion. Distortion of sound may be compared with a motion picture that is out of focus. As visual distortion disturbs the eye, so sound distortion disturbs the ear. There are two types of sound distortion. Nonmusical distortion is that which orginates in the sound system itself due to poor electronic components, improper wiring, and improper circuiting. This type of distortion manifests itself as hum and other unwanted noises. Musical distortion is that which is caused by improper recording techniques. It manifests itself in a distorted or unreal sound. Nonmusical distortion is found in most commercial radios and phonographs. In high fidelity, however, the components are designed to keep distortion at an absolute minimum. All sounds are clean and clearly defined.

The second characteristic which provides realism and presence is the ability of quality high fidelity equipment to reproduce, as naturally as possible, the entire tonal spectrum. Not only are the fundamental notes reproduced, but also their overtones which give identity to musical instruments. The range of sound audible to the human ear lies between fifty cycles per second and nineteen thousand cycles per second. Those overtones which are not audible but which add realism and presence lie at the ends of this tonal spectrum. High fidelity equipment reproduces a very large portion of this spectrum which results in realism and presence.

The third characteristic is balance of tone. The balance of tone is as important to musical enjoyment as the balance of color is to a painting. For true musical enjoyment, the "tone colors" of a musical performance must be balanced properly, with the high notes and low notes maintained in the same relationship as in the original performance. High fidelity components are designed to maintain this proper tonal balance and to reproduce it in your home.

Much confusion has arisen about the

terms high-fidelity and true-fidelity. Fidelity is a measure of faithfulness of reproduction, and the term high fidelity necessarily refers to a high degree thereof. For practical purposes, however, the subjective factor of pleasurable listening must also be considered. While faithful reproduction and pleasantness are related, the two terms are not always synonymous. We may therefore say, "True fidelity reproduction is that which is indistinguishable from the original and involves the technical problems of exact reproduction." For example, noises which are heard on records, such as hiss and clicks, lie at the high end (high frequency) of the tonal spectrum. In high fidelity provision is made for these frequencys to be kept from the loudspeaker, thus resulting in slight loss of certain high frequency tones. Although certain notes are altered, the overall effect is more pleasurable. This is high fidelity rather than true fidelity. The belief that an extension of the frequency range always results in an increase in pleasurable listening is a fallacy.

Because of the distortion and loss of high frequency in commercial radios and phonographs, an interesting phenomenon known as listening fatigue has evolved. Listening fatigue is a recognized psychoacoustic effect which eventually makes the listener either subconsciously dislike (and ignore) music being played, or (in extreme cases) compels him to shut off the source. High fidelity eliminates listening fatigue and adds much pleasure to music listening.

It has been found that a good many persons actually dislike high fidelity response until they have been "educated" (or re-educated) by a few hours of listening. The undiscriminating listener does not detect distortion until it becomes excessive, and therefore he may be satisfied with sound reproduction that would greatly displease the ear of a trained listener. High fidelity brings out all sounds on a record. Thus record noise and poor performance which are hidden by poor equipment are readily heard on high-fi apparatus.

We see that high fidelity is a means of reproducing the realism and presence of the concert hall in the home. It accomplishes this feat by eliminating distortion, extending frequency response, and maintaining tonal balance. It eliminates unwanted elements from the music and eliminates listener fatigue, thus bringing pleasure to the music lover. Now let us examine the mechanics of high fidelity to see how this modern miracle of sound reproduction is accomplished.

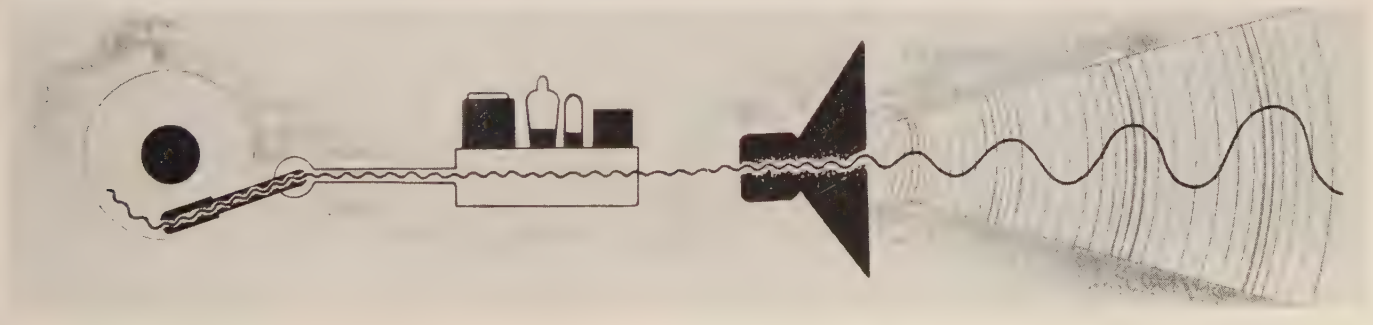
A basic high fidelity sound system is composed of turntable, pre-amplifier, amplifier, speaker, and speaker enclosure. It is the purpose of the turntable (record player) to provide the signal (input) necessary for the high fidelity system to operate. In this case the input is music. The record player is composed of motor, drive system, turntable-disk, pick-up arm, stylus, and cartridge. A specialized motor and drive system is used in high fidelity equipment to keep distortion at a minimum. The motor must not vary in speed, as this introduces distortion into the system. The drive system makes possible speed changes which are necessary to accommodate the various records produced today. Most turntable-disks are heavy enough to provide a flywheel effect so as to eliminate slight variations in speed.

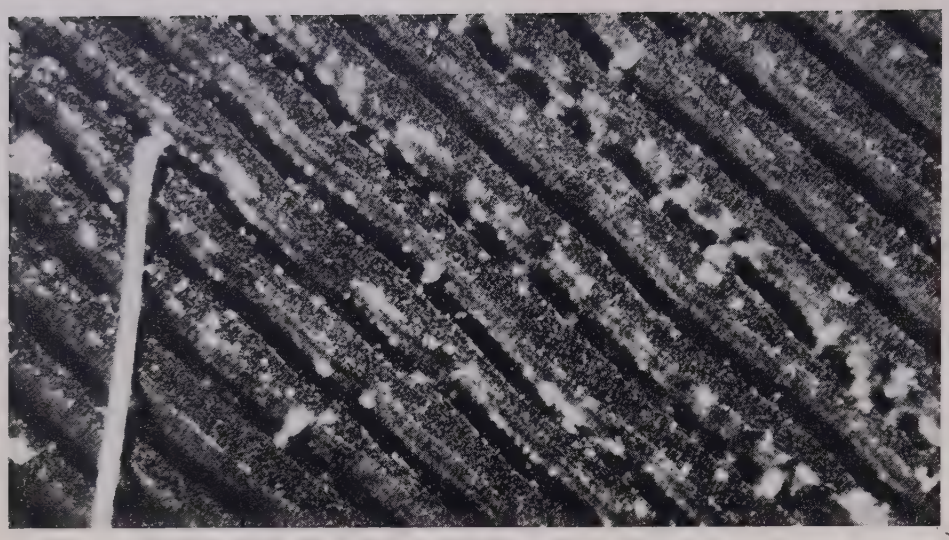
The pick-up arm carries the pick-up, composed of stylus and cartridge. Music is recorded on a record by means of grooves. In reproduction, the stylus travels these grooves, vibrating from side to side. The cartridge changes these mechanical vibrations into electrical impulses. The stylus must be very fine to get all the music that is recorded on the grooves. Diamond styli are recommended as they can be made very fine and last longer than other types. The cartridge must have a wide range (thirty to fifteen thousand cycles per second) and low hum and distortion characteristics. The pick-up arm must be light so that stylus pressure on the groove is not too great. Excessive stylus pressure results in record damage and short stylus life. The pick-up arm must also have good tracking characteristics (i.e. good contact between stylus and groove).

The electric impulse generated by the cartridge is very minute and must be strengthened or built up before it can be turned into sound. This impulse is generally fed into a pre-amplifier (or pre-amp). The pre-amp increases (electronically amplifies) the signal enough so that it can be fed into the main amplifier. The pre-amp serves a secondary purpose in many sound systems, namely that of control center. There are generally six controls in a pre-amp. The first of these is a combination on-off switch and a volume control. The second is a selector switch so that various inputs such as phonograph, microphone, F.M. or A.M. tuner, and television tuner may be selected. The remaining four switches are used to compensate for different recording characteristics.

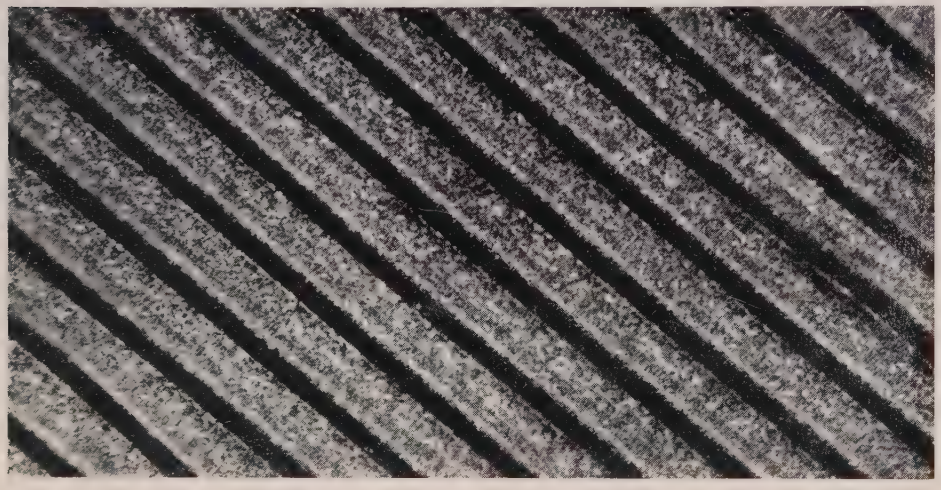
All record companies have their own standards for recording music. Each standard is based on the dominance of certain frequencies, and recording techniques follow a curve based on these frequencies. Provision is made in many pre-amps to compensate for these various curves so that the sound is reproduced as recorded, with the same frequencies being stressed. In addition to two compensating controls there are separate controls for bass (low frequency) and treble (high frequency) response. These controls generally have a position marked "flat response." In this position no emphasis is placed on bass or treble and the sound is reproduced unaltered. The hi-fi listener can stress either bass and/or treble response and obtain reproduction which is most pleasurable to him.

The compensated signal is now fed into the main amplifier, the heart of the hi-fi system. The purpose of the amplifier which is the most nearly perfect component of a hi-fi system, is to boost the signal without adding any distortion. This is accomplished by the use of special circuits and high quality components. The amplifier must be able to accept a wide range of frequencies and levels, and amplify them in proper relationship to their musical volume. For example, signals generated by a solo instrument must be amplified and reproduced so the solo can be heard in proper relationship to the accompaniment. The accepted range that a hi-fi amplifier must accept and faithfully amplify is from twenty cycles per second to twenty thousand cicles per second. Amplifiers are rated





An example of proper and poor care given to high fidelity zynelite records. The above picture was taken after 100 uses with normal care. Lower picture shows the result of a proper needle, proper handling, and careful brushing before and after each use. (Photos courtesy of High Fidelity, a Fawcett Publication.)



by the amount of power they can deliver, measured in watts, and the amount of distortion produced at this power level. The amplifier must be capable of delivering peaks and crescendos without adding distortion or being taxed beyond its limits. The trend today is toward high powered amplifiers (15 watt output or greater), as engineers feel that clean, well defined sound at any volume necessitates powerful amplifiers.

From the amplifier, the strengthened signal is sent to the sound reproducer. The term loudspeaker is a misnomer as the loudspeaker actually reproduces the increased signal from the amplifier so that it can be heard by the human. The sound reproducer is the least developed yet most important link in the hi-fi chain. Without a good speaker system, speaker and enclosure, all the quality hi-fi components are useless. A good speaker system enhances the sound of a poor hi-fi unit while a poor speaker system ruins the sound of a good hi-fi unit.

Speakers come in many shapes and sizes but all operate on the same principle. They all change electrical impulses into audible sound. This is accomplished by the use of a magnet and voice coil. As the intensity of the impulse varies, the position of the voice coil changes in relationship to the magnet. Attached to the voice coil is the cone, usually constructed of plastic impregnated cloth. The movements of this cone set air particles surrounding the speaker into motion. It is these particles in motion that cause sound.

High fidelity reproduction requires the use of at least two speakers. One of these speakers is used to reproduce bass (low frequency) notes. This speaker, called the woofer, is generally large and circular. The second speaker, called the tweeter, is used to reproduce treble (high frequency(notes. The tweeter is much smaller than the woofer but similarly constructed. Often these speakers are mounted one inside the other, or coaxially, giving rise to the term coaxial speaker. Some means of diverting high frequencies to the tweeter and low frequencies to the woofer must be used. Both electrical and mechanical devices to accomplish this have been developed. These devices are called crossover networks.

It remains now only to add an enclosure to complete the basic hi-fi system. Many people consider the enclosure merely as a housing for the speaker. Actually the enclosure is an integral part of the hi-fi system. It will be recalled that in changing electrical impulses to sound air was set in motion. However, the cone of the speaker sets not only the air in front of it in motion but also the air behind. The rear waves caused by the speaker are often reflected from a hard surface. such as a wall, and meet the waves issuing forth from the front of the speaker at a different time cancelling them out and causing distortion. Enclosures eliminate this type of distortion.

Enclosures range from the simple infinite baffle type to the complex horn type. An infinite baffle is the type of enclosure that merely separates the front wave from the back wave. An example of this would be a speaker mounted in the door of a closet. In addition to elimination of destructive cancellation, the more complex horn type enclosures are designed to extend the bass response of the system, thus adding greater realism and presence. One type of enclosure can extend the bass range below the limit of audibility where low frequency notes are felt as changes in room air pressure rather than sounds.

We have learned what is meant by the term high fidelity and what components are necessary to achieve high fidelity sound reproduction. Now let us consider the factor that are causing many people to become avid hi-fi boosters. High fidelity approaches the realism and presence of performance heard in the concert hall, with the added advantage of being able to select music according to one taste. Music reproduction far exceeding the average commercial radio and phonograph combinations can be achieved at a comparable price. Elimination of listening fatigue relaxes and brings enjoyment to the listener.

High fidelity equipment while by no means inexpensive, is within reach of most music lovers. In truth, a very expensive sound system may sound no better than a moderately priced one. There is no technical or financial yardstick. The quality of a hi-fi system is measured by its ability to please the discriminating listener. A hi-fi system should be a personal item with components chosen to give the listener the most pleasurable sound available at the price he can afford to pay. Careful consideration and listening will reward the hi-fi buyer

At David Sarnoff Research Center, Princeton, N. J., RCA tests one of loudspeakers used in new high fidelity "Victrola" phonographs.

RCA creates a new kind of high fidelity in the silence of this room

In this room you *can* hear a pin drop. The jagged walls absorb alien noise so that delicate instruments can make sure reproduced sound matches the original as closely as possible.

Thus a new kind of high fidelity is born—and brought to you for the first time in new RCA Victor Orthophonic "Victrola" phonographs. *Listen!* Here is distortion-free performance through the range of audible sound. Here is *more* music than you've ever heard before. Here is the ultimate in high fidelity.

The skill behind new Orthophonic "Victrolas" is inherent in all RCA products and services. And continually, RCA scientists strive to open new frontiers of "Electronics for Living"—electronics that make life happier, easier, safer.

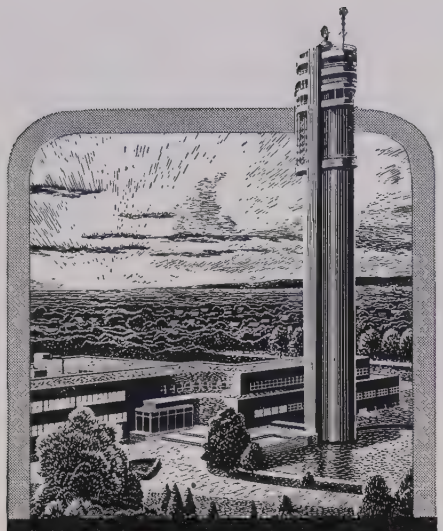
WHERE TO, MR. ENGINEER?

RCA offers careers in research, development, design, and manufacturing for engineers with Bachelor or advanced degrees in E. E., M. E. or Physics. For full information, write to: Mr. Robert Haklisch, Manager, College Relations, Radio Corporation of America, Camden 2, N. J.

RCA®

RADIO CORPORATION OF AMERICA

Electronics for Living



A Tower of Opportunity

for America's young engineers with capacity for continuing achievements in radio and electronics

Today, engineers and physicists are looking at tomorrow from the top of this tower . . . the famed Microwave Tower of Federal Telecommunication Laboratories . . . a great development unit of the world-wide, American-owned International Telephone and Telegraph Corporation.

Here, too, is opportunity for the young graduate engineers of America . . . opportunity to be associated with leaders in the electronic field . . . to work with the finest facilities . . . to win recognition . . . to achieve advancement commensurate with capacity.

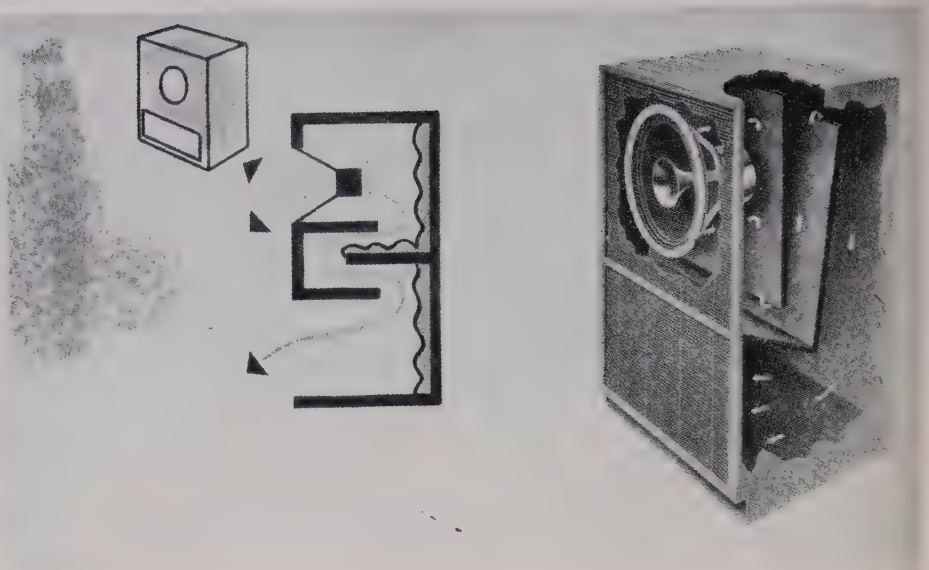
Learn more about this noted Tower of Opportunity...its long-range program and generous employee benefits. See your Placement Officer today for further information about FTL.

INTERESTING ASSIGNMENTS IN—

Radio Communication Systems
Electron Tubes
Microwave Components
Electronic Countermeasures
Air Navigation Systems
Missile Guidance
Transistors and other Semiconductor Devices
Rectifiers • Computers • Antennas
Telephone and Wire Transmission Systems

Federal Telecommunication Laboratories

A Division of International Telephone and Telegraph Corporation
500 Washington Avenue, Nutley, N. J.



Diagramatic view of sound box put out by a commercial company. These boxes may be made by hand and thus a personalized sound effect given the owner-listener.

with years of enjoyable easy listening.

Though many of the interesting details and sidelights of high fidelity are beyond the scope given here, it is hoped that the reader will have gained a bit of knowledge about, and much interest in, high fidelity. A new world of enjoyable listening is yours for the asking.

BIBLIOGRAPHY

Briggs, A. A., *Loudspeakers.* Bradford Road, Eng: Wharedale Wireless Works, 1951.

Briggs, G. A., *Sound Reproduction.* Bradford Road, Eng: Wharfedale Wireless Works, 1953.

Carver, Jay. "The Rebel," *Radio and Television News,* Vol. 53, No. 6, (June, 1955), 46-47.

Clifford, Martin, ed., *High-Fidelity Design, Construction, and Measurements.* New York: Gernsback Publications, Inc., 1953.

Fowler, Charles. "Toward The Clean Crescendo," *High Fidelity,* Volume 5, Number 5, (July, 1955) 38-39.

Frayne, John G., and Halley Wolfe. *Elements of Sound Recording.* New York: John Wiley and Sons, Inc., 1950.

Greene, Irving, and James R. Radcliffe, *The New High Fidelity Handbook.* New York: Crown Publishers, Inc., 1955.

Karlson Enclosure, The. New York: Karlson Associates, Inc., 1954.

Kolodin, Irving, ed. *The Saturday Review Home Book of Recorded Music and Sound Reproduction.* New York: Prentice-Hall, Inc., 1952.

Newitt, John H. *High Fidelity Techniques,* New York: Rinehart and Company, Inc., 1953.

Preamplifier. Benton Harbor: Heath Company, 1954.

This is High Fidelity. Chicago: Allied Radio Corp., 1954.

Thomas, William M. "Choosing Your Precision Transducer," *High Fidelity,* Volume 5, Number 10 (December, 1955), 18-19.

Wellman, William R. *How to Build Your Own Radio and Hi-Fi Sets.* New York: Popular Science Publishing Co., Inc., 1954.

Wharfield, E. C. "Take Pen in Hand," *High Fidelity,* Volume 5, Number 9 (November, 1955), 38-39, 109, 111.

"Williamson Type" Amplifier, Benton Harbor: Heath Company, 1954.

Ch. E. 372 Exp. No. 6

LITTLE BLUE ROTAMETER

95
F.S.P

(The report you are about to read is true. Only the data has been changed to give a smoother curve.)

Monday, October 5

1:00 P.M.—My name is Chuck Wolfenberger, my partner's name is Ivan Burgener. We were working the day watch out of the Unit Ops Lab. For some time there had been a rotameter, with a suspiciously large discharge coefficient, lingering in the vicinity of Mezzanine A. Our job—calibrate it.

2:00 P.M.—Mezzanine A. We disassembled and inspected the rotameter. (Ser. No. B-25410). In it we found what I had suspected all along—an orifice. Tracing the air line six feet upstream beyond the Iron Case Meter (No. 1229298) we discovered an on-and-off safety valve. It looked like an open and shut case.

2:09 P.M.—We reassembled the apparatus.

2:15 P.M.—We began taking data; flow rate, monometer reading, rotameter reading.

2:42 P.M.—Increased the flow rate steadily to a value of 100 cu. ft. per second. The monometer and rotameter readings remained constant at zero during this time.

6:17 P.M.—Still taking data. We just want the facts. Connected the monometers and rotameter to the air line. Got much better data.

6:17 P.M.—Plotted curves from the data of flow rate vs. rotameter reading, flow rate vs. pressure drop, and pressure drop vs. rotameter reading. They were identical.

6:17 P.M.—The conclusion was obvious. We had the answer. The pressure drop had to be constant. What a beautiful curve it made. A straight line. We plotted it over and over. How did we know the pressure drop was constant? We played a hunch, that's all; sometimes a hunch pays off, sometimes it doesn't; we just played a hunch.

6:17 P.M.—My watch had stopped at 6:17 p.m.

Tuesday, October 6

9:00 A.M.—We were all washed up. Our data were excellent, our curves were in agreement with theory, but we had made one fatal mistake. The jig was up. What was wrong? We neglected to plot our curves on log-log paper.

On October 9, 1953, trial was held in Superior Court, Room 116 E. Chem. The report was graded and found to be highly improper. The penalty for failing to use log-log paper is a grade of not less than F— or more than E+.

A BOLD APPROACH TO MISSILE ELECTRONICS

a statement by DR. L. N. RIDENOUR, *Director of Research, Lockheed Missile Systems Division*

Electronics is central to the technology of guided missiles. Dramatic improvements in missile performance require faster, more accurate perceptions and reactions of electronic missile guidance and control systems.

Here at the Missile Systems Division of Lockheed, we are aware of this requirement. We also know that electronics is experiencing the greatest revolution in its history; the vacuum tube, hitherto the cornerstone of electronic design, is being replaced by new solid-state devices which have superior performance and reliability.

Thus the times favor a bold approach to missile electronics. Techniques of the past will not meet requirements of the future. Experience in old-fashioned electronics is no great qualification for the present challenge. By giving the broadest possible responsibility to our scientists and engineers, we are trying to lay proper emphasis on the new electronics.

Lockheed MISSILE SYSTEMS DIVISION *research and engineering staff*

LOCKHEED AIRCRAFT CORPORATION • VAN NUYS, CALIFORNIA

HOW HERCULES HELPS...

IN HEAVY TRAFFIC AREAS like this, floor tiles must be built to take a beating. Whether the tiles are of the rigid, mastic type or flexible flooring based on rubber or vinyl, Hercules Neolyn®, Mastolyn® or Staybelite® resin can contribute to lower processing costs and better wearing qualities. The wide variety of properties offered by these resins assures that there is one best suited for every floor tile formulation.

MORE THAN 17,000 VOLUMES of scientific literature and tens of thousands of company research reports will be housed in this new $1,000,000 Technical Information Center at the Hercules Experiment Station near Wilmington. In addition, the structure will provide quarters for the many technical specialists who serve the scientific information needs of the Hercules research staff—making the Center one of the nation's most complete information services to an industrial research organization.

WHICH HAD THE TREATMENT? The clean, unsplintered piece has been treated with Hercules Paracol® wax emulsion, making it possible to use every inch of lumber that has been pre-cut at the mill. The untreated piece (top) is badly "checked" and a portion of the end must be discarded before it will be suitable for use.

G55-13

HERCULES POWDER COMPANY
INCORPORATED
968 Market St., Wilmington 99, Del. Sales Offices in Principal Cities

SYNTHETIC RESINS, CELLULOSE PRODUCTS, CHEMICAL COTTON, TERPENE CHEMICALS, ROSIN AND ROSIN DERIVATIVES, CHLORINATED PRODUCTS, OXYCHEMICALS, EXPLOSIVES, AND OTHER CHEMICAL PROCESSING MATERIALS.

HERCULES

CHEMICAL MATERIALS FOR INDUSTRY

WOMEN *ARE* for ENGINEERING

by Francis Scott, T.E. '58

Recently we published an article from another magazine which attacked the idea of women in engineering. From another source, the "Auburn Engineer" of Alabama Polytechnic Institute, comes an article written by Francis Scott, a sophomore in Textile Engineering, in which she explains why she is going into engineering. While it was not written directly in reply to the other article, it represents the other side of the story.

"Why? is a question I've often been asked since I entered as a freshman in Textile Engineering last fall. To begin with, I did not choose engineering because my father was an engineer—he's not—nor did I enter with the sole idea of having purely masculine classes. I chose engineering in general because of my love and aptitude toward mathematics and technical subjects, and Textile Engineering in particular because I felt that it best reconciled my art work —I once planned to major in art—and my leanings toward a technical field. Having now spent a year's time in the T. E. curriculum I feel I chose wisely.

Besides Textile Engineering combining my widely diversified interests so satisfactorily, there is the added advantage that engineering is a generally lucrative field—at least for men—with the demand far exceeding the supply at present.

With the demand so great and the supply so limited, it seems logical to assume that industry would be urging interested women to enter the engineering field. Such does not seem to be the case. Officials appear reluctant to accept feminine engineers on the same basis with men. One such official, upon being informed that I was in T. E., was most enthusiastic over my choice, heartily pointing out in utter sincerity what a wonderful secretary I was going to make for some textile executive! After I spend four—or more—years poring over physics and calculus books and finally receive my degree, I can assure you that a secretarial position is hardly the peak of my ambition!

Acceptance of the feminine engineer on an equal basis with males would have many advantages for the industrial world. For one thing, a wider choice of qualified graduates would be afforded—giving industry a much better chance for employing really capable engineers, rather than having to "scrape the bottom of the barrel" as they have been doing. Then too, placing qualified women engineers in so-called "men's jobs" would free the men for use in spots where they only can be used.

Once industry wakes up to the fact that women would be the answer to most of its employment problems, it must go "a-wooing." Women would like assurance before entering the "man's world" that they will be considered for promotion and useful work strictly on a merit basis with the men they work beside; that they are not just substitutes until enough men are available to fill the positions; and that they will be given a chance to utilize their technical knowledge and training and not be just "fancy" secretaries or technicians.

I chose engineering because I like it, and I feel that when I graduate I will be just as capable in most positions as the boys with whom I graduate. Textiles in particular should have a place for me—I only hope that I will be allowed to fill it.

Planning Today for . . .

Tomorrow's Highways

By John Brennon, Ag. E. '59

Eight months after the end of World War I the Secretary of War, Newton D. Baker, initiated a transcontinental truck convoy to prove that the gasoline engine had displaced the mule, even on the country's relatively primitive roads. The convoy left Washington July 7 and arrived in San Francisco sixty days and six thousand breakdowns later. At that time there were 7,600,000 cars and trucks and 300,000 miles of all weather roads in the United States. Today there are well over 56,000,000 cars and trucks travelling over 1,800,000 miles of all weather roads. This trend of the American people to make increasing use of motor vehicles especially for freight transportation has raised the engineering problem of building safer and more durable highways at the lowest possible cost. It is for this reason that the AASHO Road Test was proposed in 1951.

Early activation of the road test, which will cost at least $12 million, became a certainty with the announcement of the American Association of State Highway Officials, at its November 1954 meeting in Seattle, that the number of participants willing to join in the proposed test was sufficient to make its financing feasible. At that time forty-four states had declared their intention to back the project with cash contributions. Industry participants have indicated a willingness to furnish the necessary vehicles, fuel and tires.

Following official activation of the project late last spring, the location and soil surveys were made. The preparation of the construction plans and testing of the soil samples are under way. The acquisition of right-of-way for the project has recently begun. If the present schedule can be maintained it is believed construction can begin in the early summer of 1956.

The New Jersey turnpike is an example of planned highway construction. Highways of this type must be designed to withstand the wear and tear as well as the volume of traffic.

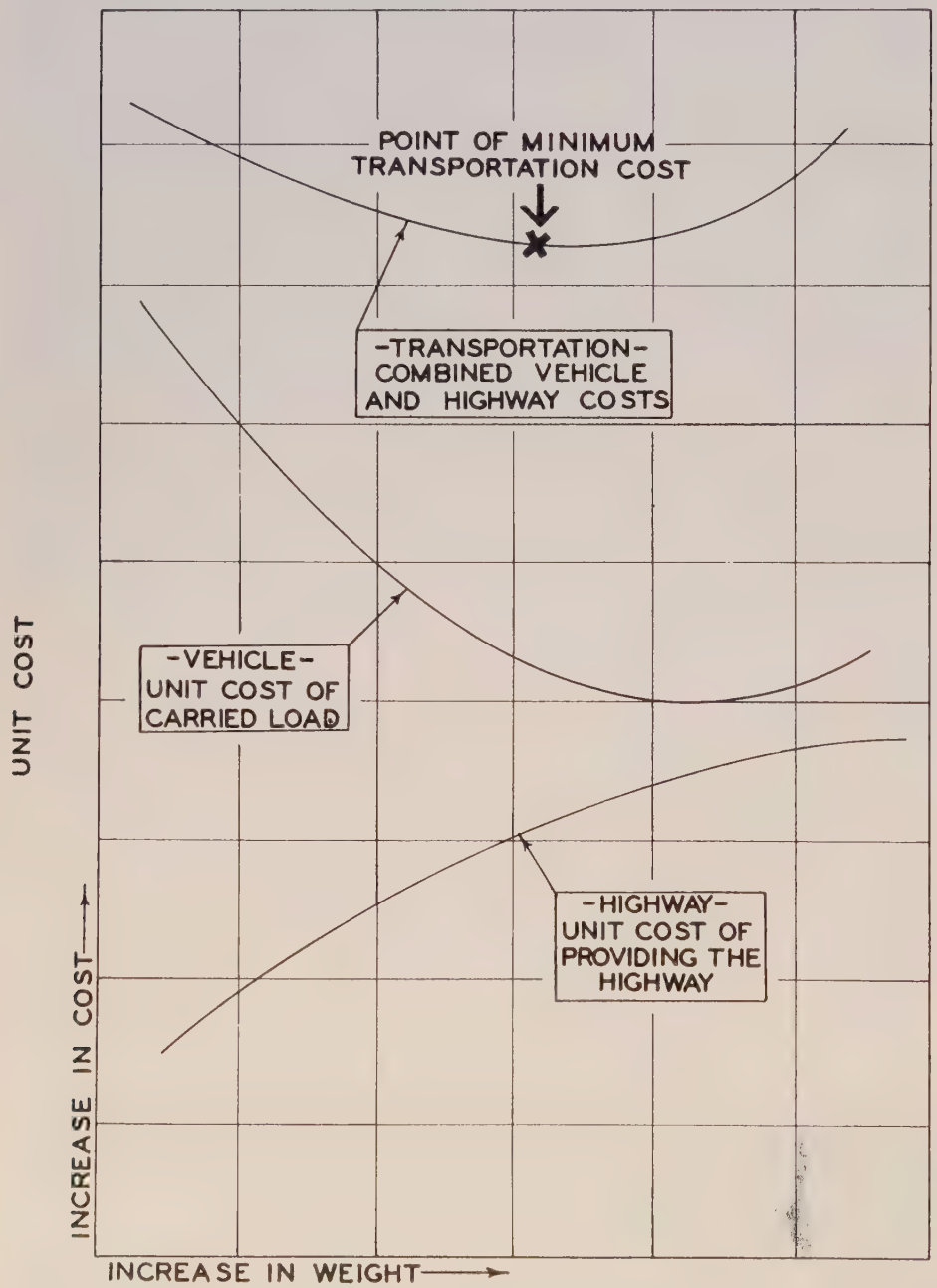
A major part of the preliminary ground work, excluding the making of financial arrangements, has dealt with the development of the work program for the test project. This has been in the hands of a 20-man working committee under the leadership of E. A. Finney of the Michigan Highway Department. W. Emmitt Chastain Sr., Engineer of Physical Research, represented the state of Illinois on this working committee.

Today, the highway administrators are faced with the double problem of protection of present pavements from further damage by over-loaded vehicles, while at the same time building new pavements and strengthening the old to provide load-carrying capacities sufficient to withstand the loadings of vehicles of whatever weight which will

result in the lowest over-all transportation cost to the general public.

The devising of a method of fair and equitable taxation of highway users is another related problem of importance to the highway administrators. Although several methods have been proposed none has yet been found universally acceptable. Although the proposed study is concerned primarily with providing information of value in establishing advantageous load regulations, the value of the study in furnishing information upon which a formula for equitable taxation of all highway users may be based should not be overlooked.

The over-all transportation cost is of a two-fold nature. It not only involves the cost of highway construction, maintenance and operation but it also involves certain other costs which must eventually be paid by the individual for his travel and for the transportation of the goods that must reach him. The accompanying graph shows the nature of the expense and of the problem that is involved. As the weight of the vehicular load increases the cost of providing a pavement which will carry the increased load also increases. This is depicted by the middle curve on the graph. The sum of the values on the two curves is the total cost of transportation. This is indicated by the top curve on the graph. The point at which the combined costs are a minimum, as shown on the top curve, is believed to be the point of greatest economy of transportation. It is believed that at this point the vehicle and highway costs are in the best balance. It is believed that this project will provide the necessary data to determine this point, which at the present is not known.


POINT OF MINIMUM TRANSPORTATION COST
-TRANSPORTATION- COMBINED VEHICLE AND HIGHWAY COSTS
-VEHICLE- UNIT COST OF CARRIED LOAD
-HIGHWAY- UNIT COST OF PROVIDING THE HIGHWAY
UNIT COST
INCREASE IN COST
INCREASE IN WEIGHT
GROSS VEHICLE LOAD

THE HIGHWAY TRANSPORT PROBLEM
ECONOMIC AND ENGINEERING

Truckers seem to believe that they can operate more efficiently with heavier pay loads. Evidence of this can be seen in the use of vehicles of greater hauling capacity, the high number of arrests for over-load violations and the persistent pressure that is being applied to promote legislation raising the present load limit. However, the rising maintainence cost combined with a visual observation of the condition of many of our major truck highways give sufficient evidence of the general inability of our present day highways to support the increased loads to which they are subjected.

Factual engineering information must be given to the administrators to guide them in establishing the load limits that will be of the greatest financial advantage to the general public. The information must present a full picture of the construction and maintainence costs of highways having various axle loads, and of the initial and operating costs of the vehicles of various weights and capacities which will use the roads. In this way the administrators will be able to determine a balance which will result in the lowest over-all transportation costs.

The AASHO Road Test has, then, been proposed to develop data that will aid in the solution of what is basically an economic problem, though engineering is intimately involved. The Road Test, in which the behavior of pavement under various loads will be studied, offers the possibility of a solution to the problem depicted by the lowest curve on the graph. The AASHO is well aware of the other phase of the problem that deals with operating costs, and preliminary steps are being taken to develop a study of over-the-road operating costs of vehicles of various weights.

Shortly after that transcontinental truck convoy completed its westward journey motor vehicle traffic became an increasingly important factor in this nation's economic structure and the country's road building era got under way. The Illinois legislature authorized the sale of $60,000,000 in bonds followed a few years later by a $100,000,000 issue, for the construction of hard-surfaced roads.

The expenditure of such large sums of money inspired intensive research activities within the Department of Public Works and Highways. This research work centered around test roads near Bates, Illinois. Hence these projects were known as the Bates Test Road. Here trucks of axle weights varying

The Importance of Cable Engineering and Design

Cable engineering is concerned with the design and use of wires and cables to direct the flow of electrical energy from its source to the point of utilization. It is generally more economical to generate electric power in relatively large blocks at strategically located power plants and to transmit it over relatively long distances than to generate in small quantities where it is used.

There are, therefore, two general types of wires and cables used in the electrical industry:

(a) those used for power transmission, usually at voltages above 22 kilovolts,

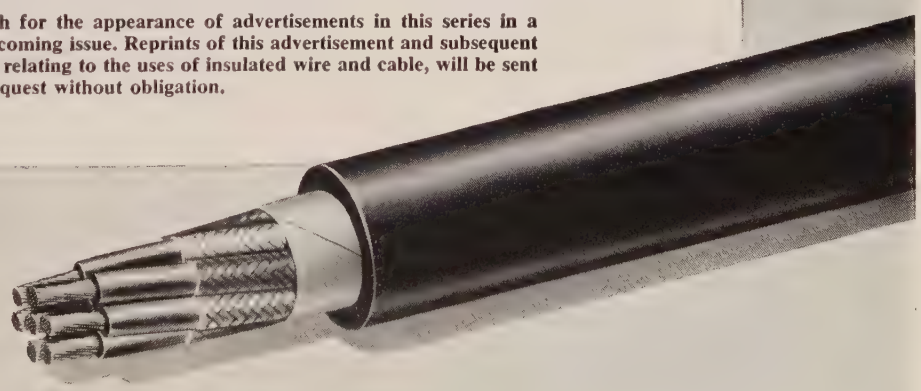
(b) those used for power distribution at lower voltages.

Cables used for power transmission are generally single conductors with no insulation. They are supported on insulators above ground at such separations or spacings that the air provides the required insulation. For power distribution, on the other hand, where the space occupied by the power line is important, insulated cables are used. This discussion deals with the design and use of insulated wires and cables for power distribution systems.

Insulated distribution cables carry power from the transformer stations along the transmission lines to its point of ultimate utilization. The voltages at which power is distributed vary from about 15 kilovolts to 115 volts used in individual homes. The higher voltages are used for the distribution of relatively large amounts of power from the transformer stations to substations nearer the points of utilization, such as industrial plants, where it is transformed to low or utilization voltages, either alternating or direct current. Large quantities of electric power are distributed in this way and the value of the distribution equipment required is great. The value of the insulated conductors, including those for both portable or stationary installations, probably exceeds that of any other single item used in power distribution. The design and operation of insulated conductors and distribution systems are of great public and commercial importance. The primary function of insulated cable engineering and design is to provide safe, adequate, reliable and pleasant appearing distribution systems. Electric power is so extensively used in modern life that interruptions to it are serious. The failure of electrical power in an industrial plant throws people out of work and reduces production.

The appearance or sightliness of cables installed overhead in a community is important and is attained chiefly by installing such cables with a small and uniform sag from pole to pole.

Watch for the appearance of advertisements in this series in a forthcoming issue. Reprints of this advertisement and subsequent ones, relating to the uses of insulated wire and cable, will be sent on request without obligation.



Electrical Wire & Cable Department

United States Rubber

from 5,000 pounds to 26,000 pounds were driven over the major road surfacings of the day. The pavements were divided into sections varying in thickness and strength from light to heavy. At that time, even as today, truck loadings were of prime concern to highway engineers.

The results of the Bates Test Road were applied to highways throughout the nation. Thousands of miles of pavement were laid in Illinois and other states during the 1920's and early 1930's based on the standards developed in these studies. The fact that the standards of the Bates Test Road were eminently successful in pointing the way toward roads of sufficient load-carrying capacity for the loadings of the day is attested by a statement that Thomas H. MacDonald, Commissioner, Bureau of Public Roads, made in 1931. At that time he said, "The roads are more destroyed really by climatic and soil conditions than they are by any use that is made of them."

With the entrance of this country into World War II and the increased traffic caused by the war effort the destructive effects of heavy loadings again became of prime importance to highway engineers. The standards of the Bates tests became antiquated and roads built on its standards, when faced with the greater axle loads, began failing at a rapid rate. Old roads were being repaired and new ones were being made thicker, without the aid of satisfactory experimental data, in hope that they could withstand the pounding of the ever increasing loads.

Realizing the urgent need for factual information regarding the load-carrying characteristics of the present highways, a group of interested highway officials banded together in 1949 to form the Interregional Council of Highway Transportation. The Maryland Test Road was a result of the action taken by the council. Eleven state highway departments (including the Illinois Division of Highways), the District of Columbia and the Bureau of Public Roads participated financially in this study which was administered by the Highway Research Council. The truck manufacturers of the Automobile Manufacturers Association furnished the trucks and the petroleum industry furnished the oil and grease. The principle objective of the test was to furnish information regarding the effects of various axle loads on one design of pavement on a non-uniform subgrade. This test resulted in increased knowledge of the relationship existing between loads, road and subgrade. It did not, however, give highway engineers and administrators the necessary information to design pavements and determine the loads they can carry without undue economic loss through short life and excessive maintenance expense.

The Western Association of State Highway Officials, recognizing the worth of information concerning the performance of flexible pavements initiated the WASHO Road Test in 1951. The special pavement was built at Malad, Idaho in the summer of 1952. Two test tracks were constructed and connected at the ends with turn-arounds. Testing was begun in the fall of 1952 and finished in the early summer of 1954. The results issued in early 1955 will have considerable influence on the flexible pavement design. The experience gained on this project will also contribute greatly to the success of the AASHO Road Test project.

As mentioned previously, a comprehensive road test, to yield maximum returns, must not only consist of a study of the physical behavior of pavements, but also include a complementary study of the cost of operating vehicles under various conditions of load and road. This is necessary if we are to arrive at an acceptable figure for over-all transportation costs. Vehicles, however, must be studied as the vehicles are operated under over-the-road service conditions. Such a study is contemplated to run concurrently with the road test project.

As the thinking for the Road Test crystallized it became evident that even on a project as large as this only a certain number of variables could be brought to bear. With this in mind the committee assigned to take care of program planning decided that the main objective of the testing should be to help solve these three problems:

1. What additional highway costs can be justified to permit the use of heavier trucks than are now allowed.
2. How to design pavements that will carry present and future traffic loads.
3. What share of the highway costs should be borne by the operators of various classes of vehicles.

Once the main objective of the study was established, certain limitations were placed on the variables that were to be studied. Practical aspects such as financing placed further limitations on the variables that could be studied. After a consideration of all the factors involved the committee decided that the study would be concerned with the following variables: (1) weight of applied loads; (2) type of pavement (rigid and flexible); and (3) thickness of the various pavement components. No new or untried designs will be used and the soil types are not intended major variables. The pavement, therefore, will be standard with the exception that some portions will, on the basis of present knowledge, be under designed for the intended loads while some portions will be designed to carry the applied loads and other portions will be over designed. This variable thickness is necessary because of the present uncertainty as to the relationships which exist.

After the objectives of the test were determined certain requirements were set that a test site must meet to become acceptable. Among these requirements were: (1) The area must be reasonably representative of a major part of the country climatically; preferably with a rainfall of 35 to 45 inches and a frost penetration of 25 inches. (2) The area must be of the fine grades type which presents problems in the construction of both rigid and flexible pavement surfaces. (3) The area must be fairly level, one where the cut and fill will not be enough to constitute a major variable. (4) The location should be one where a section of dual pavement will be needed, but at the same time one that can be kept closed to the traffic for the time needed for the testing. The site which best suited these requirements and was chosen as the place for the test is located just north of the existing Route U.S. 6 between Ottawa and LaSalle, Illinois.

The test project will be about eight miles in length and will consist of four loops each having an over-all length of about 1½ miles. These four loops will consist of dual 24-foot pavements separated by a standard parkway and connected at the ends by turn-arounds. The sections containing the major variables will consist of lengths of 250 to 500 feet and there will be 12 to 24 of these sections in each loop.

Both single and double axle trucks of various loadings will be used, however, only one type of truck at a constant load will be driven over each individual lane. Single axle loadings will be 10,000 lbs., 18,000 lbs., 22,400 lbs., and 30,000 lbs. Tandem axle loads will be 20,000 lbs., 32,000 lbs, 40,000 lbs., and 50,000 lbs. The 10,000 lb. single axle and the 20,000 tandem axle loads will operate on one loop; the 18,000 lb. single axle and the 32,000 lb. tandem axle loads will operate on another, and so on. It is expected that 48 trucks will be used. In addition to the construction workers, test truck drivers and maintenance crews, a staff of 200 technical men will be needed to conduct the testing which is expected to continue for two years following the completion of the pavement. Experts in the fields of highway and bridge design, highway materials and electronic field instruments will be needed if the test is to be properly conducted.

If all progresses as planned 1962 will see the issuing of the first report of the AASHO Road Test.

Let The Man With The Facts tell you about careers with Westinghouse

You have a tough decision to make . . . about that all-important first job. Which company offers you your best future?

Let The Man With The Facts discuss with you the varied and challenging opportunities at Westinghouse.

He is a man with broad personal experience who can tell you the specific things you want to know . . . the many kinds of careers . . . training program . . . further education . . . advancement . . . how you can grow with Westinghouse.

Westinghouse is one of the fastest growing companies in America. It is expanding rapidly into challenging new fields like atomic power, semiconductors, director systems, automation. Let The Man With The Facts tell you about these and many other fields that offer almost unlimited opportunities . . . at Westinghouse.

It's your decision, but before you make it, ask your Placement Officer to make a date with the Westinghouse Man With The Facts. In the meantime, ask for your copy of our 48-page book, *Finding Your Place in Industry.*

G-10291

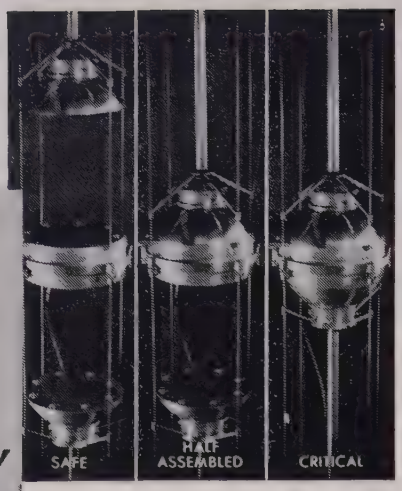
YOU CAN BE SURE...IF IT'S

Westinghouse

Ask your Placement Officer about career opportunities at Westinghouse, or write for these two booklets: *Continued Education at Westinghouse* (describing our Graduate Study Program) and *Finding Your Place in Industry.*

Write: Mr. C. W. Mills, Regional Educational Co-ordinator, Westinghouse Electric Corporation, Merchandise Mart Plaza, Chicago 90, Illinois.

BARE PLUTONIUM SPHERE...



UNIVERSITY OF CALIFORNIA
LOS ALAMOS SCIENTIFIC LABORATORY
(CONTRACT W-7405-ENG-36)
P. O. BOX 1663
LOS ALAMOS, NEW MEXICO

"JEZEBEL"

...NEWEST OF THE CRITICAL ASSEMBLIES AT LOS ALAMOS...

--where scientists and engineers, working with some of the Western World's finest equipment and facilities probe the unknown and seek answers to tomorrow's problems.

The Laboratory's program for pioneering in nuclear and thermonuclear power and nuclear propulsion, ranks in importance with the Laboratory's continuing and ever expanding achievements in atomic weapons research and development.

The delightful small city of Los Alamos is situated among the pines on the lower eastern slope of the towering Jemez Mountains—an ideal community and climate in which to live and raise a family.

For employment information contact your Placement Office or write

DEPARTMENT
OF
SCIENTIFIC PERSONNEL
Division 7

los alamos
scientific laboratory
OF THE UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

Techno-Cutie

for

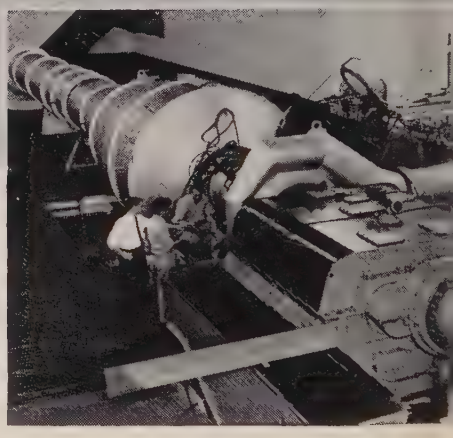
March

☆

Miss March is Miss Ruth Ann O'Neil, a junior from Bloomington, Illinois. Ruth is in the College of Commerce, majoring in secretarial training. In her spare time, she enjoys horseback riding, swimming, playing cards, reading, and sleeping. Ruth was an Illio beauty last year and she was also a Dolphin Queen finalist and a candidate for I.F. Queen. Structural wise, Ruth is 5'9" up, 36-24-35 around various sections, and she weighs 130 pounds. This nineteen-year-old member of Alpha Phi is also engaged, so hold the phone, you wolves.

it takes many engineering skil

McDonnell "Voodoo", *the most powerful jet fighter ever built in America.*



MECHANICAL ENGINEERS are concerned with many phases including experimental testing and development, mechanical design, stress and vibration analysis, combustion research, heat transfer and nuclear reactor development.

J-57 POWERED AIRCRAFT

MILITARY

F-100	F8U
F-101	A3D
F-102	B-52
F4D	KC-135

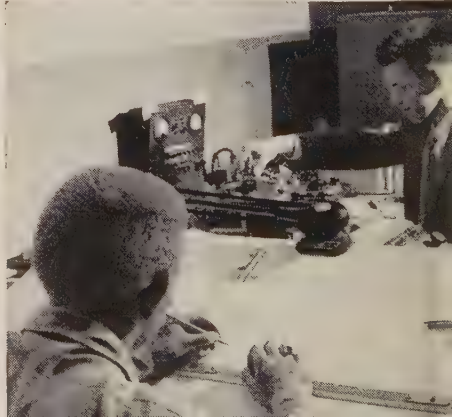
COMMERCIAL

Boeing 707

Douglas DC-8

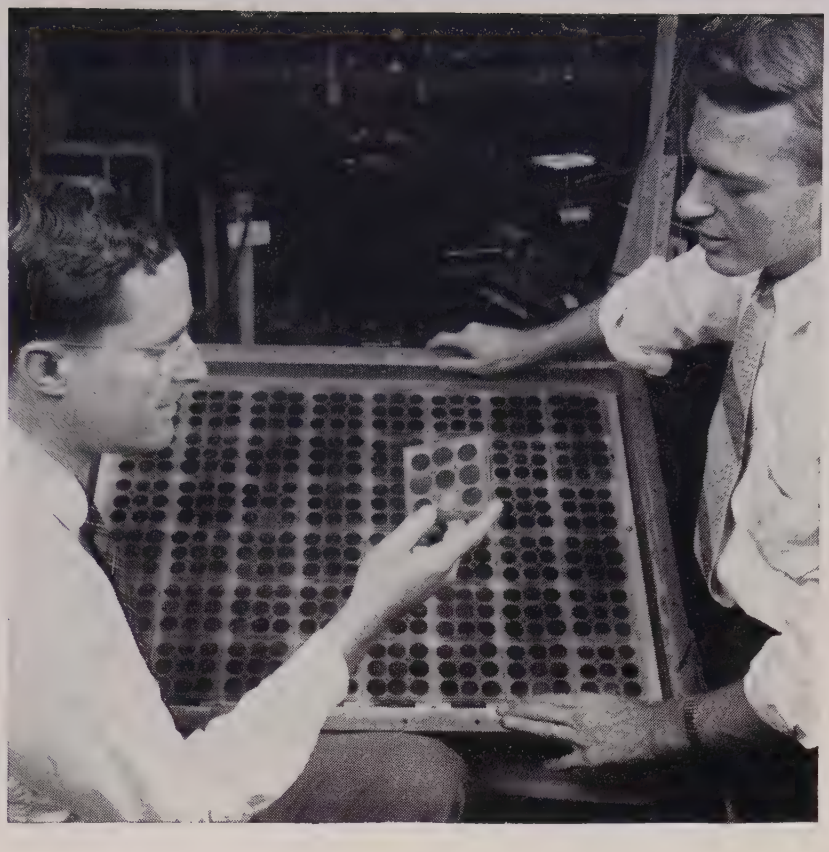
AERONAUTICAL ENGINEERS work on innumerable internal and external airflow problems concerned with design, development and testing of aircraft powerplants. Some who specialize in analytical engineering forecast engine-airplane combinations a decade in advance of design.

ELECTRICAL ENGINEERS directly contribu their specialized skills to the analysis a development of controls, systems and speci instrumentation. An example is the "Plott mat" which automatically integrates and plo pressures, temperatures and air angles performance testing.



How the Bell Solar Battery Converts Sunlight into Electricity

Another example of the pioneering opportunities for engineers at Bell Telephone Laboratories



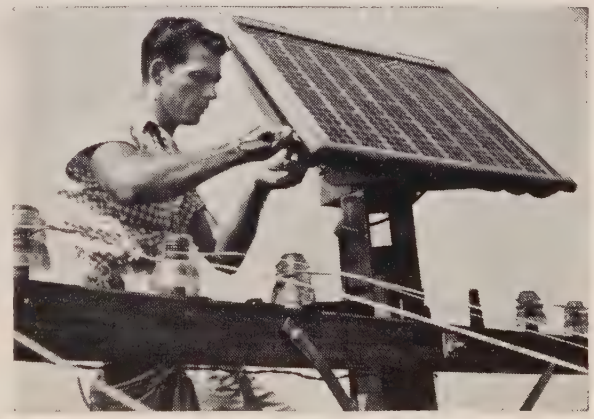
In a career with Bell Telephone Laboratories, young engineers and scientists can expect to take part in pioneering radically new developments in the field of communications. One such development is the Bell Solar Battery.

Like the transistor, the Bell Solar Battery was invented by Bell System scientists. Indeed, it was the study of semiconductors which revealed the fact that sunlight could induce the movement of electrons in silicon and thus create electric current.

The basic unit of the Bell Solar Battery is a thin disc compounded of two kinds of treated silicon. The body of the disc is silicon with a trace of arsenic to provide negative potential. Into this body boron is diffused, to a depth of less than 1/10,000 of an inch, providing positive potential. The junction of these layers of treated silicon is the "*p-n*" junction. Equilibrium between the *p* and *n* regions is upset when the disc is exposed to sunlight, which jolts electrons free, and causes them to move across the *p-n* junction. The charges pass through contacts, and current — though a small amount — flows.

In the past year, the efficiency of the Bell Solar Battery has been increased from 6 to 11%. Right now, in Americus, Georgia, the battery is being used experimentally to power a rural telephone system. And more widespread application is in the offing.

The Bell Solar Battery is one of many developments underway in the Bell System to improve America's telephone service. The special role of Bell Telephone Laboratories in forwarding the exciting search for tomorrow's better telephone service is creating many fine career opportunities for young scientists and engineers. Your placement officer can give you more information about careers with Bell Telephone Laboratories, and also with Bell Telephone Operating Companies, Western Electric and Sandia Corporation.

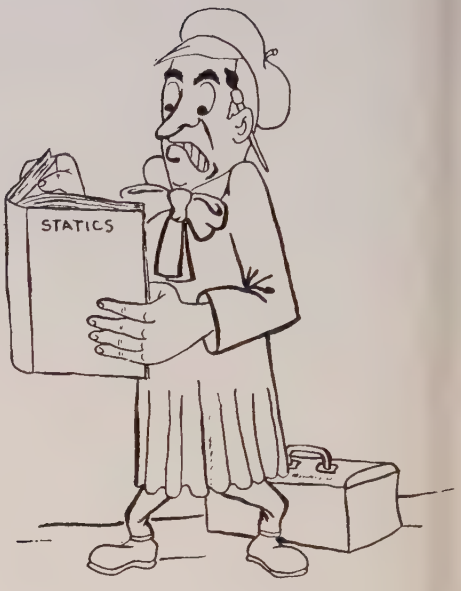


The Bell Solar Battery consists of 432 silicon discs wired together. It is mounted on telephone poles to catch prevailing sunlight, and on a sunny day can produce 10 watts. Excess energy is fed into storage batteries, to be used at night or in bad weather.

BELL TELEPHONE SYSTEM

SLIDERULE SLIPPERS

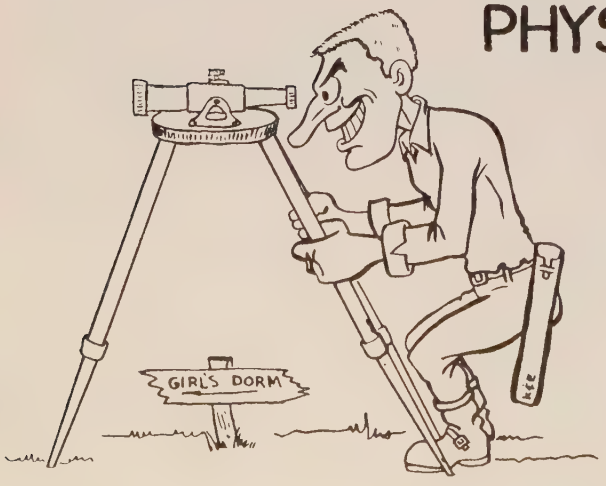
by
DON GATES



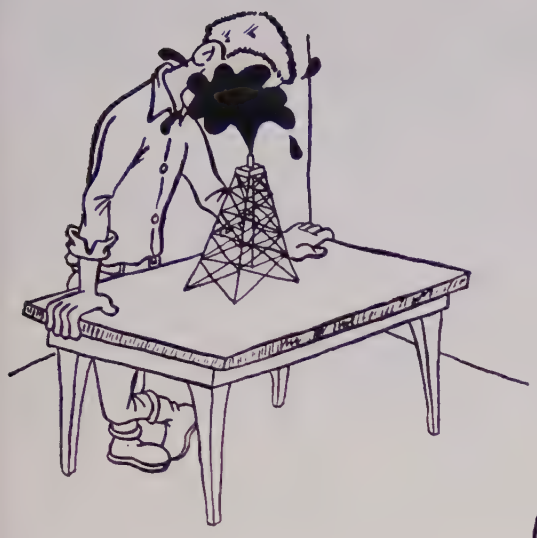
ARCH.

GEOL.

PHYSICS



CIVIL

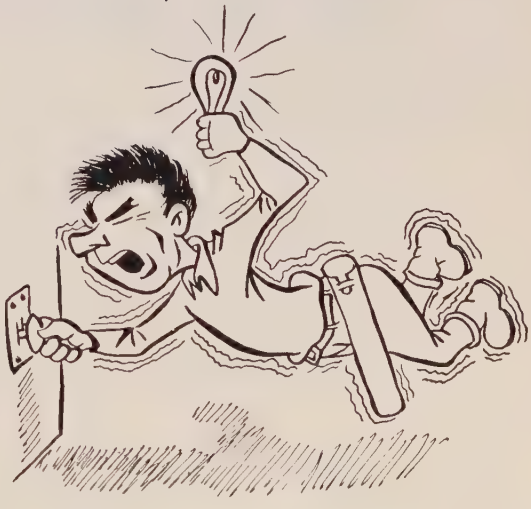


PETROL.

MECH.

AERO.

CHEM.



ELEC.

MIN. & MET.

—From Kansas Engineer

SLIDING DOWN THE WAYS at Groton, Conn., goes the USS Nautilus, newest and fastest member of our underseas fleet. During welding, Worthington heavy-duty turning rolls rotated the hull sections.

How the world's first atomic sub was welded

Welding the hull of the USS Nautilus, world's first atomic submarine, presented a tough problem.

Submerged-arc automatic welding seemed to be ideal for the job. Question was—could you rotate the hull sections of the Nautilus to take advantage of this fast, high-quality welding method?

Worthington's answer to General Dynamics Corporation's Electric Boat Division, builder of the Nautilus, was the largest turning roll ever built.

The result? Welding of the Nautilus hull was accomplished in record-breaking time — and cost less than originally estimated. Unchanged, the Worthington roll set-up is also being used in the construction of the nation's second atomic sub, the USS Sea Wolf.

Turning rolls for submarines aren't all that Worthington makes. The long list of Worthington-designed, Worthington-built equipment includes air conditioning units, construction machinery, compressors, Diesel engines, steam power equipment and, of course, pumps of all kinds. For the complete story of how you can fit into the Worthington picture, write F. F. Thompson, Manager, Personnel and Training, Worthington Corporation, Harrison, New Jersey. You may be glad you did.

4.25 B

See the Worthington representative when he visits your campus

See the Worthington Corporation exhibit in New York City. A lively, informative display of product developments for industry, business and the home. Park Avenue and 40th Street.

WORTHINGTON

When you're thinking of a good job—think high—think Worthington

AIR CONDITIONING AND REFRIGERATION • COMPRESSORS • CONSTRUCTION EQUIPMENT • ENGINES • DEAERATORS • INDUSTRIAL MIXERS
LIQUID METERS • MECHANICAL POWER TRANSMISSION • PUMPS • STEAM CONDENSERS • STEAM-JET EJECTORS • STEAM TURBINES • WELDING POSITIONERS

For Engineers, a . . .

UNIFIED CURRICULUM

by Richard W. Hradek

The following article was first published in the "Iowa Transit," engineering magazine of State University of Iowa. We believe that it contains items of interest for all engineering students in the light of its proposed revolutionary innovations.

A change in curriculum is being discussed in engineering circles these days. This type of curriculum would replace the present specialized curricula used for mechanical, electrical, civil, and chemical engineering. Thus, all engineers would be required to take the same college courses under the unified curriculum, and all engineering graduates would receive identical degrees in the general field of engineering.

The State University of Iowa, College of Engineering has already adopted a small phase of the unified curriculum. This was done when a three-credit-hour course entitled "Engineering Analysis" was introduced in the fall semester of 1954. The purposes of the course are given in the course description which states, ". . . Engineering Analysis is being offered to train engineers in the ability to think constructively in more than one branch of engineering and to show the mathematical similarity between problems of a highly varied nature."

The introductory notes for the course state, ". . . the engineer who has studied and concentrated just enough more to obtain a firm grasp of the fundamentals which are common to the various branches of engineering has a decided advantage over others in pursuing his career. By being able to recognize immediately the analogies which exist for a certain problem and thereby see alternate, and possible simpler and less costly methods of solution, he will find that he is more valuable and capable . . ." Thus, a significant step toward a unified curriculum has been made, and there is talk among some faculty members about instituting a completely unified program in the near future.

Let us examine the reasons for having a unified curriculum. The essential task that faces an engineering student is to prepare himself to handle elementary problems immediately upon graduation and to have acquired the background to proceed in the direction that his employment opportunity presents. These things can be accomplished by a strong unified educational program that includes the common disciplines and the differentiating characteristics of the various branches of engineering. Probably the biggest difference between the activities of the several branches of engineering lies in the different systems. The differences in the systems can be reduced with a unified curriculum. For example, a vibrating mechanical system may be completely represented by an electrical circuit, and the calculations that can be made for the circuit will hold for the mechanical system. The basic differential equations describing the two systems are identical in form, and thus in the proper system of units, calculations can be transferred from one system to the other. Such similarities can be best demonstrated under a unified curriculum.

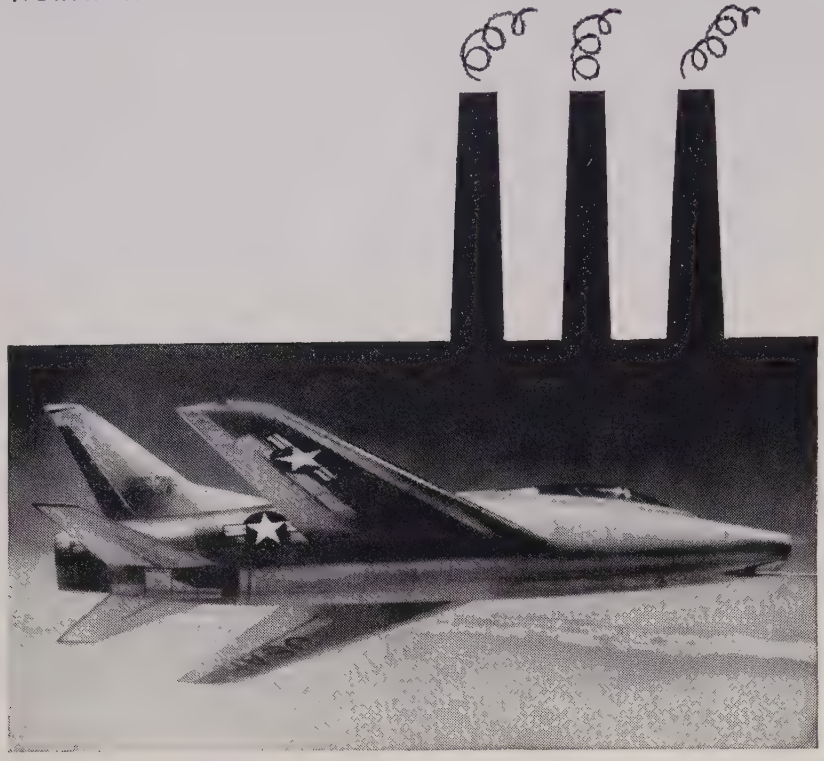
Differences in technical language and nomenclature have developed around the different systems that can be classified as structures, machines, circuits, processes, earth, and combinations of these. This makes it hard for the specialized engineer to understand the terms used in branches of engineering other than his own. The unified curriculum will aid in reducing these language differences since all engineers would become familiar with the same basic terms.

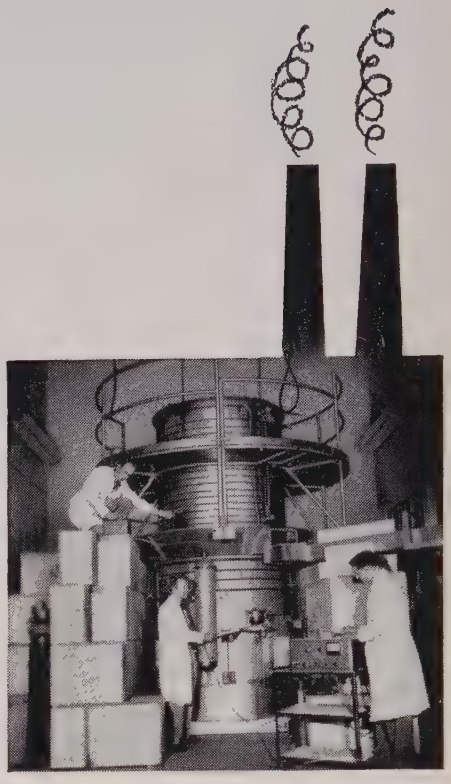
The unified curriculum can contribute to the education of the student in a specialized field, but there is some question as to whether this is desirable. This could be accomplished by allowing the student a number of electives from which he could obtain a small degree of specialization. There are three reasons why this variation might not be desired. The first reason is that the education of the student in the art can be accomplished more effectively by industry as a part of the industrial experience of the engineer. This is because industrial organizations are in a position to know exactly what they want their employees to know in specialzied areas. Another reason is that the engineering colleges must not be used as trade schools. If this happens, the sci-

UNIFIED CURRICULUM FOR THE COLLEGE OF ENGINEERING IN THE UNIVERSITY OF CALIFORNIA AT LOS ANGELES

	Units First Semester	Units Second Semester
Freshman Year		
Military Science or Air Science	1.5	1.5
Physical Education	0.5	0.5
General Chemistry	5	5
Surveying Lectures	2	
Descriptive Geometry		3
Surveying Field Practice	1	
The Anatomy of Engineering	1	
Properties of Materials		2
Analytic Geometry and Calculus	5	3
General Physics		3
	16	18
Sophomore Year		
Military Science or Air Science	1.5	1.5
Physical Education	0.5	0.5
Elementary Mechanics	3	3
Differential and Integral Calculus	3	3
General Physics	3	3
Electives	7	7
	18	18
Junior Year		
Circuit Analysis	3	
Electrical Machines		3
Engineering Dynamics	3	
Eleemntary Fluid Mechanics		3
Junior Engineering Laboratory	3	3
Heat Transfer and Thermodynamics	3	3
Strength of Materials	2	
Advanced Engineering Mathematics	3	
Electives	1	6
	18	18
Senior Year		
Senior Engineering Laboratory	4	4
The Engineer and His Professional Duties	2	
Electives	12	12
	18	16

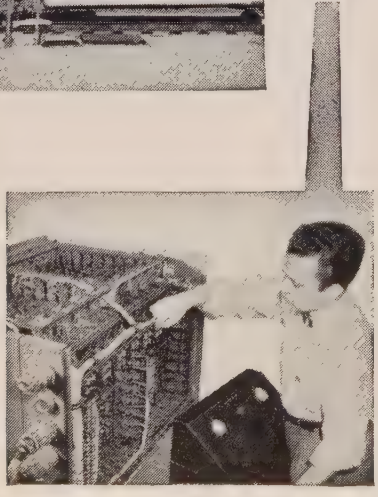
NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD





At North American—

DIVERSITY CREATES OPPORTUNITY



Graduates, undergraduates—A North American representative will be on your campus soon. He will give you complete details on the hundreds of openings these expanding fields create: AIRCRAFT: the Korea-famed F-86 SABRE JET, the record-smashing F-100 SUPER SABRE, and Airborne Vehicles of the Future. GUIDED MISSILES: the SM-64 NAVAHO Intercontinental Guided Missile. ELECTRO-MECHANICAL CONTROLS: fire controls, automatic navigation systems, flight control computers—for aircraft and missiles. ENGINES: lightweight, high-thrust rocket engines for the NAVAHO and for other missile programs. ATOMIC ENERGY: the development of nuclear reactors for research, medicine and power.

North American engineers work in top-level teams, share in a liberal Patent Award Program, a highly successful Suggestion Award Plan and many other unexcelled job benefits.

See the North American Representative at your school... or write:

Mr. Stevenson, Dept. 56-CM
Engineer Personnel Office
North American Aviation
Los Angeles 45, California

Mr. Kimbark, Dept. 9120-CM
Engineer Personnel Office
North American's Missile & Control Departments
Downey, California

Mr. Pappin, Dept. 56-CM
Engineer Personnel Office
North American's Columbus Division
Columbus 16, Ohio

ENGINEERING AHEAD FOR A BETTER TOMORROW

NORTH AMERICAN AVIATION, INC.

ence of engineering will not continue to advance as fast as possible, since colleges have provided a favorable atmosphere for research. Besides, trade schools are available to those who desire this type of education. Another reason is that the state of the specialized field is constantly and rapidly changing. Therefore, the details that a college student learns in a specialized field many times become obsolete before he has a chance to put them to use. Probably only a certain amount of specialization in a certain field is desired on a college level ,and this can easily be provided in a unified curriculum.

The content of a unified curriculum would be a broad and liberal nature. According to Dean L. M. Boelter of the College of Engineering for UCLA, the divisions of such a curriculum might be as follows: physical sciences, biological sciences, languages of communication, properties of materials, applications to components of engineering systems, professional engineering, and general education. These divisions show the broadness of a unified curriculum. This broad nature is made possible by eliminating many of the courses usually taught in a specialized curriculum.

In a new curriculum, the content of some courses should be eventually changed. For instance, strength of materials and analytic mechanics might be easier to comprehend if they were combined into a single course instead of being taught separately as they now are. This is because analytic mechanics is applied throughout the strength of materials course. The mechanics of fluids and solids might be taught together to illustrate differences and similarities between the two. Another example would be to apply the techniques of circuit analysis to systems other than electrical. Also, attention should be given to the continuity of student experiences. Therefore, no time gap should exist between the instruction of the mechanics in the physics courses and the introductory course in mechanics as administered in the advanced engineering courses.

Engineering works are based on materials. The properties and uses of materials should continue to receive concentrated attention. the several materials should be studied to observe the separate properties. That is, the mechanical, magnetic, electrical, thermal, and other properties should be observed and their interrelations noted. To give a complete picture, the properties and behavior of living tissue and bones should be given with the usual engineering materials.

Solutions to engineering problems are found by using analytic methods (derivations and calculations) or by using experimental methods or the judicious use of both. The engineer must be capable of both methods upon graduation. Parallel learning of the two methods (analytic and experimental) would be emphasized in a unified curriculum.

The laboratory exercises then become more than demonstrations of the behavior of systems. The laboratory becomes a workshop in which to find solutions through experimentation. The laboratory courses will be set up to provide experience in measuring and instrumentation, in properties of materials, in unit operations, and in engineering systems. The term "unit operation" means using experimental stations to discover phenomena such as the following: flow of a fluid through a channel or over a surface; behavior of a circuit containing inductors, capacitors, and resistors; or absorption, transmission, and reflection of radiant energy. The engineering systems will be studied by using replicas (models or prototypes) of actual systems. Complete power plants, production systems, irrigation systems, and many others will be used for instruction purposes. Major emphasis will be put on each of the subdivisions noted above in the freshman, sophomore, junior, and senior years respectively, but each of the four subdivisions will also be represented in the other three years.

At the present time, there is only one large engineering college using a unified engineering curriculum. UCLA has only one curriculum for all of its engineering students. This engineering college was approved by the state legislature in 1943, and therefore has been in existence a relatively short period of tim . Furthermore, the complete curriculum was not available until 1948, so it is hard to determine the merits of the unified curriculum with such a short testing period.

The unified engineering curriculum now being used at UCLA is shown in the accompanying figure. This curriculum is supposed to contain the fundamentals for all of the different branches of engineering. An inspection of this curriculum will show that all of the branches are represented to some degree. Another notable thing about this curriculum is the large number of elective courses. Forty-five hours of electives are allowed and can be used for some specialized field. The remainder of the courses are designed to qualify the engineer in any branch of engineering.

If the State University of Iowa were to adopt a unified engineering curriculum, it would be the second major school to do this. The unified system has some decided advantages over the specialized system, and therefore, this unified system should be given further study at the State University of Iowa. A change to the unified would seem to be revolutionary and a step toward an improved educational system.

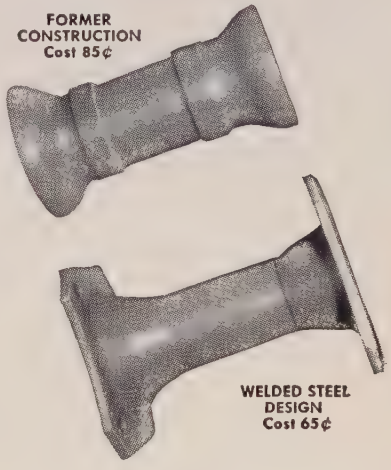
WHAT'S THE TREND IN PRODUCT DESIGN?

It affects your future as a development engineer

INDUSTRY'S forecasts predict constantly growing competition for customers. As a result, tomorrow's designs will be based on two major premises: dependability and cost.

With rising costs of materials and labor, industry is searching for ingenious engineers to show them how to develop and manufacture their products at a profit . . . and still keep selling prices down.

The engineer who knows how to use materials like welded steel to eliminate unnecessary cost will command key positions in industry. Welding holds the answer to many design dilemmas where costs must be cut and products made stronger, more rugged.

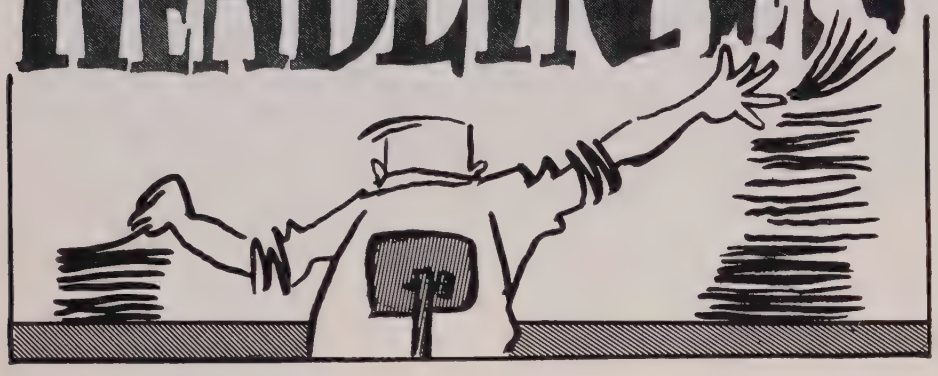


The example shows how one machine component has been made more durable... yet the cost was cut from 85¢ to 65¢ a piece. Because of steel's higher strength, greater rigidity and lower costs, similar reductions in cost are possible in virtually all products now made from gray iron.

Latest design ideas in changing over parts from gray iron to steel are available to engineering students by writing

THE LINCOLN ELECTRIC COMPANY
Cleveland 17, Ohio
The World's Largest Manufacturer of Arc Welding Equipment

SKIMMING INDUSTRIAL HEADLINES



by Larry Kiefling, M.E. '56

Radio Frequency Lamp

Using the same type of radio signal that transmits sound to radio and television receivers, a new multi-purpose lamp was introduced. The lamp transforms radio impulses into light so brilliant that it is brighter than any incandescent lamp ever devised.

The lamp is not connected by wires to the source of its activating energy. Known as the RF (Radio Frequency) lamp, it was originally designed by Sylvania engineers, in cooperation with the Motion Picture Research Council in Hollywood, to overcome a number of motion picture printing problems. The RF lamp can also be used in color television tube processing, medical research, radar and air traffic control, computers, film projectors and many other fields.

It provides a concentrated and uniform source of light—so concentrated that nearly all the light produced by the lamp is usable. The new lamp was shown to movie-makers in Hollywood.

Immediate advantage of these characteristics of the RF lamp is being taken by the motion picture industry which is already using the lamp in film printing operations. By using the RF lamp, the motion picture industry now can increase the speed of critical film printing operations up to eight times faster than it could using conventional methods. The speed with which Hollywood will now print these films is limited by the mechanical speed at which the film can be run through the printing equipment rather than by the quantity of light available. In addition to these substantial savings in time in film printing, the uniformity of RF illumination has resulted in a noticeable improvement in the quality of the print.

First commercial installation of the RF lamp was made by Consolidated Film Industries. The use of the light source in optical printing equipment resulted in increased uniformity of field, exceptional increase in light output, and greater lamp life. Eventual conversion of all optical printing equipment to RF light is predicted. The present usage of RF for color separations and negatives is only the initial stage in wide-spread laboratory applications.

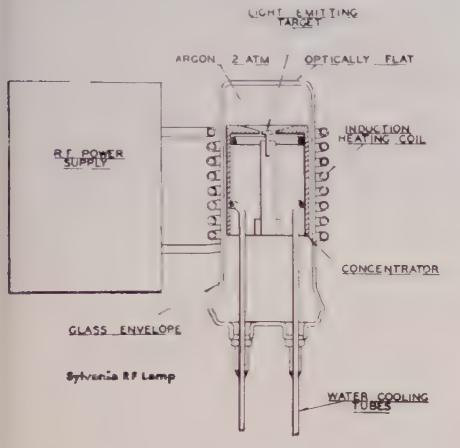
Engineers now are working on the possibility of employing the RF lamp for studio set lighting. He pointed out that with the advent of wide-screen color motion pictures, many times more light is needed in filming to gain the necessary depth of focus. In supplying this quantity of light the temperature on the studio set frequently rises to a point at which it becomes a problem to both actors and technicians. The RF lamp conducts out the heat which in other lamps is transferred into the air.

The RF lamp also permits radar images to be projected onto a screen. This

Bright lights may be the reward of stardom, and the brightest of all incandescent lamps is explained to actress Dani Crayne by Sylvania engineer Richard H. Lindeberg (left). The new light source is powered by radio frequency, similar to the signals transmitted by television and radio stations. It emits a bright, uniform light especially suitable for use in motion picture film printing. Looking on is Jack Thomas, head of Universal-International's special effects department.

has found immediate application in an air-traffic radar device presently being produced under military supervision.

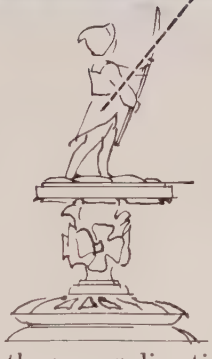
"In this fast moving jet age there is no longer time to plot the location of planes on a large board as has been the practice," said Mr. George C. Conner, Sylvania executive. "Planes now move so fast that danger of collision can occur during the time the aircraft are being plotted. With the RF lamp, the radar targets can be projected directly on a ten-foot square screen and the movement of the planes observed immediately. Not only does this mean more safety for the flying public, but the application opens up many useful applications for the military."



This same principle was being applied in medical research. For example, with the use of RF illumination, scientists will be able to project microscope images of tissues on a large screen to determine whether cancer cells are present. The excellent uniformity and brilliance of RF illumination permits more perfect images than were possible previously.

The RF lamp already has resulted in an important production improvement in the manufacture of color television picture tubes. In manufacturing color tubes, the three phosphors which are used, red, green, and blue, must be fixed by a photographic process. To do this, a bright concentrated light source is required. By using the RF lamp, it was found possible to cut in half the time required for this process.

The RF lamp, which is heated by induction, uses for the light-emitting source a disc of refractory material. Because the refractory material can be heated to a much higher temperature than the tungsten filaments of incandescent lamps, a great increase in light is attained. Also, because of the higher temperature, the light has a higher content of blue than does the incandescent lamp and provides more light emission in the visible range. With the use of a disc, as contrasted with the usual tungsten wire filament, the light from the lamp can be focused directly without complicated optics.



your first move
CAN DECIDE THE GAME
your first job
CAN DECIDE YOUR FUTURE

That important first job can start you off in the wrong direction—*or* it can lead you straight toward your goal. If your ambitions are high, Motorola has a place that will give you the *finest* chance possible for the advancement you want. You'll get security and good salary, but, more important, you'll be working on projects with a *future*, like missile guidance, radar, and microwave. The door is wide open at Motorola, and the opportunity to fulfill your ambitions is *yours*.

If you are an ELECTRICAL ENGINEER, MECHANICAL ENGINEER or PHYSICIST, contact Motorola today.

CHICAGO, ILL.:
Challenging positions in Two-Way Communications, Microwave, Radar and Military equipment, Television (Color) and Radio Engineering.

PHOENIX, ARIZ.:
Outstanding opportunities in the development and production of Military equipment and Transistor products.

RIVERSIDE, CAL.:
This new modern research laboratory, located 65 miles from Los Angeles, needs men in Missile and Military equipment systems analysis and design.

Contact your Placement Officer for further information regarding interview time, place and date, or write to:

MOTOROLA Engineering Recruitment Office
4501 Augusta Blvd. • Chicago 51, Ill.

Model of sodium graphite power reactor illustrating how electricity can be produced from atomic energy is demonstrated by Dr. Robert Loftness, nuclear physicist. The power reactor model represents an installation designed to produce 75,000 kilowatts of electricity, and is being considered by the Consumers Public Power District of Nebraska in their proposal under review by the Atomic Energy Commission.

Model Reactors

How the atom is being harnessed for peacetime uses was described with three dimensional working models of nuclear reactors for medical, industrial and power generation applications at the National Rural Electric Cooperative Association meeting in St. Louis, by Atomics International, a division of North American Aviation, Inc.

Four models were shown at the meeting and exhibit January 23 to January 26. Two of the models describe reactors now in construction. One is a medical reactor, now being built for the University of California at Los Angeles medical center, where it will be used for cancer therapy studies and general research in the medical field. This machine will be completed in about a year.

Another model describes an industrial research reactor to be completed for the Armour Research Foundation of Chicago this spring.The reactor will be used by Armour for a wide variety of research in the industrial field, including studies of the use of atomic radiations for food processing, textiles, petroleum,and in the chemical, paint and drug industries.

Both the medical and industrial research reactors will be "solution type" machines, using fissionable fuel in a water solution, and will operate at power levels up to 50 kilowatts.

A third model of an Atomics International designed reactor to be displayed was a "pool type" in which the core, or area of the machine where fission takes place, is located under a pool of water. This arrangement will permit the research reactor to operate at power levels up to 1,000 kilowatts.

The fourth model represented a sodium graphite power reactor showing how heat from nuclear fission can be converted to electricity. Heat from the reactor core is used to produce steam, which in turn drives turbogenerators to provide electric power.

A sodium graphite reactor of the same general type as represented by the model is now being built as part of the Atomic Energy Commission's program to develop economical electric power from nuclear energy. To be completed this year, this machine is not presently designed to actually produce electricity, but will generate 20,000 kilowatts of heat, which could be transformed into about 7,500 killowatts of electric power. The AEC is considering proposals from various organizations who are interested in "purchasing" heat from the power reactor and converting it to practical use.

Radar Jammer

General Electric revealed today that it is delivering production quantities of advanced airborne electronic countermeasures equipment (radar jammers) to the U. S. Air Force.

The units blind radar by sending out a radio signal which confuses the radar echo returned from an aircraft. Although performance details of the equipment are classified it has "considerably increased reliability and flexibility over earlier countermeasures units."

The new equipment represents "a further step in the shift of aerial warfare from bullets to electronics—a shift which began in World War 2 with widespread use of countermeasures," said Mr. H. F. Konig, G-E executive.

After the war, the government estimated that countermeasures had saved the U. S. forces in England approximately 450 heavy bombers from the effects of radar-directed enemy anti-aircraft fire.

Today's problems have increased tremendously, with planes able to bomb and fight at near-sonic speeds at altitudes well over 40,000 feet.

"Aerial warfare has become primarily an electronic duel," Konig continued, "between bombers trying to locate targets and ground defenses trying to detect and follow the bombers."

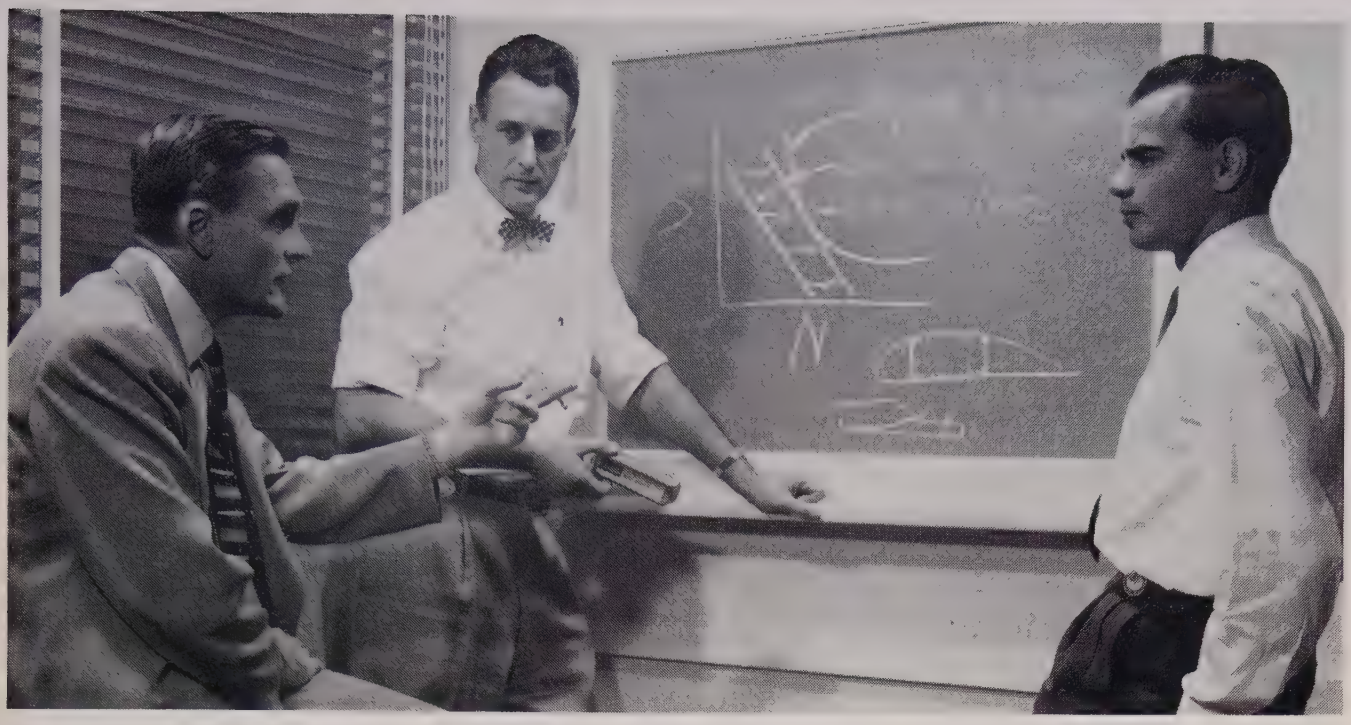
The new countermeasures equipment uses printed wiring instead of conventional wiring to save weight and bulk, improve reliability, and simplify maintenance.

Pi is used to denote the ratio of the circumference of a circle to its diameter. The short numerical equivalent is 3.14. A longer equivalent is 3.141592653589-79. Before 1500 B.C. the Babylonians, Hebrews and Chinese settled on 3 for Pi. By 1720 a Japanese had carried Pi to 50 decimal places.

Although at the present time Pi is known to 700 decimals, 10 decimal places are enough to give the circumference of the earth within a fraction of an inch and 30 decimals would give the boundary of the entire visible universe within a fraction too small to be measured by the most powerful modern microscope.

CORRECTION

The article entitled "Conquest of Space" in our January issue was miscredited to David S. Cox. Authorship credit should have been given to Norman V. Petersen, President of the American Astronautical Society. The article was reprinted from Sperryscope Magazine, the official publication of Sperry-Rand Corporation. We are also indebted to Sperryscope for permission to use the photos illustrating the article.



J. F. McBrearty, *chief structures engineer (left) discusses fatigue test program of integrally-stiffened wing lower surface structure of a new transport with E. H. Spaulding, structures division engineer and J. G. Lewolt, stress engineer. Lockheed's 500,000 lb. Force Fatigue Machine was used in test program.*

Advanced structures facilities speed careers of Lockheed engineers

Lockheed Sponsor for University of Illinois, William G. Pitt, Class of '35. *As the Lockheed sponsor for the University of Illinois, Mr. Pitt counsels students about their opportunities at Lockheed through periodic visits to the campus and through correspondence. After students join Lockheed, he maintains a close relationship with them as friend and career advisor. His work involves special assignments related to sales contact, negotiation of airplane configuration with customers and airplane specifications for various projects. He joined Lockheed in 1940.*

Engineers in Lockheed's Structures Division are supported by unmatched research and testing facilities in their constant effort to increase strength while decreasing weight.

Among those facilities are the Lockheed-designed 500,000 Lb. Force Fatigue Machine, first of its size; Shimmy Tower, only one in private industry; and Drop Test Tower, largest in the nation.

Facilities such as these give engineers a major advantage in making technical advances – and thus advancing their careers. Moreover, the large number of projects always in motion at Lockheed mean continuing opportunity for promotion as well as job security.

Why Lockheed needs Engineers with Structures training:

1. **"Fail-Safe" Structures** – Lockheed has begun an extensive pioneering effort in the new concept of "fail-safe" structures. Studies are being applied to virtually all phases of Lockheed's diversified development program – already the largest in the company's history.

2. **New studies in:** Effect of high temperatures on structures; optimization of thin-wing designs and other aero-elastic problems; new materials such as ultra-high heat treat steel; panel instability at extremely high speeds.

You are invited to contact your Placement Officer for a brochure describing life and work at Lockheed in the San Fernando Valley.

LOCKHEED

California Division • AIRCRAFT CORPORATION • BURBANK

CALIFORNIA

Book Review . . .

The Papers of Wilbu

by P. E. LaViolette

The first flight, with Orville Wright at the controls

"The buzzard which uses the dihedral angle finds greater difficulty to maintain equilibrium in strong winds than eagles and hawks which hold their wings level.

"The hen hawk can rise faster than the buzzard and its motion is steadier. It displays less effort in maintaining its balance.

"A bird sailing quartering to the wind seems to always present its wings at a positive angle, although propulsion in such seems unaccountable.

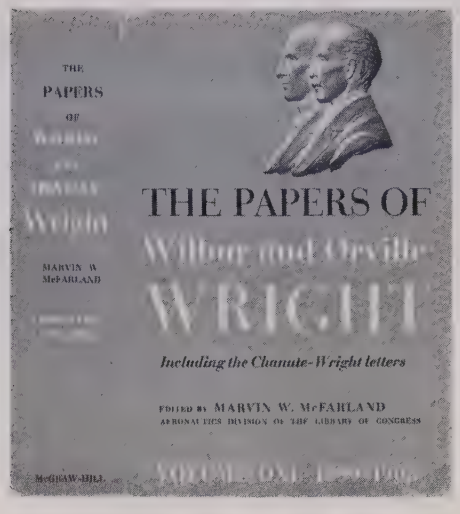
"No bird soars in a calm."

The bird-watcher making such meticulous notes on birds in flight was Wilbur Wright; the site, Kitty Hawk, North Carolina. In 1903 Kitty Hawk was a barren strip of sand on the North Carolina coast, boasting innumerable sand hills, winds of from 15 to 25 miles an hour, swarms of mosquitoes, and very few people. It was also, as noted above, an ideal spot for observing birds. Endless hours were spent by Wilbur and Orville Wright at this occupation, only to find, years later, that all their efforts at incorporating the secrets of bird flight into flight by man were useless. Orville observed many years later when discussing the Problem of Flight:

"I cannot think of any part bird flight had in the development of human flight excepting as an inspiration. Although we intently watched birds fly in a hope of learning something from them I cannot think of anything that was first learned in that way."

They did, however, utilize the other features of Kitty Hawk to advantage—the sand hills which provided excellent take-off strips for their gliders and a soft cushion for landings, and the steady winds which could nearly always be counted upon for buoyancy for their machines.

nd Orville Wright



If a strip of sand along the North Carolina coast was a strange place to expect a history-making event, the Wright brothers were even odder as inventors. Neither had a college education, or training in aeronautics. There was nothing to distinguish them; they were modest and unassuming to the point of shyness.

What they did possess was an eager interest in the problem of flight, and considerable experience with machines in their bicycle shop at Dayton, Ohio. Reading of the gliding experiments of Otto Lilienthal in Germany stimulated their interest, and they followed his attempts at flight closely. When he was killed in an accident in which his glider plunged downward suddenly and broke his neck, they decided he had done things all wrong and proceeded to draw up their own plans and to make notes based entirely on their own observations and experiments.

First they experimented with kites and small scale models of gliders. They had, unknowingly at the outset, hit upon the secret of flying which had eluded their predecessors, and which was to take them years to perfect. This was a system whereby the center of gravity remained constant and the equilibrium was maintained by raising the angle of the wing at one side and lowering the angle on the other. Thus they could balance the lift perfectly no matter what wind currents were encountered. Today all planes use this principle—it is known as aileron control.

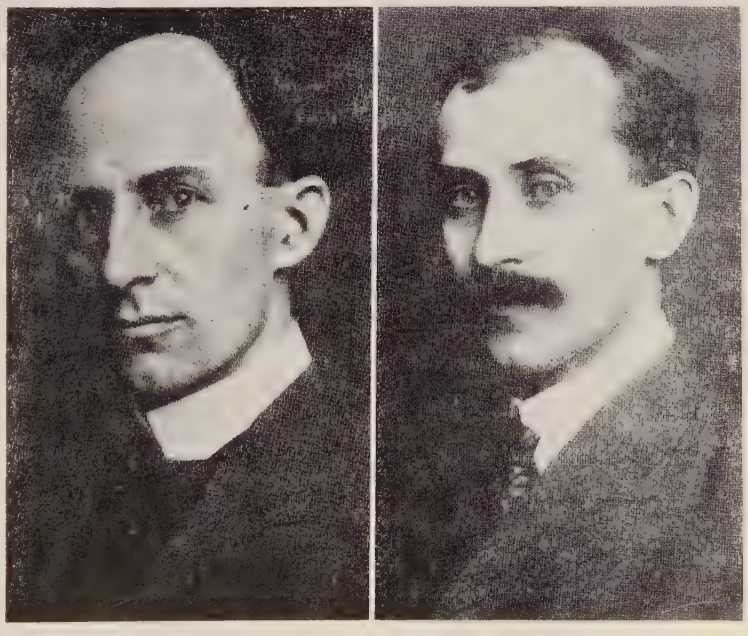
It was more difficult for the brothers to put this principle into practice than it was to arrive at it in the first place. They had originally thought of using a long shaft extending from the ends of the wings to the middle of the machine, ending in the middle with a gear. This was not feasible, however, for it seemed that a machine constructed like this would not have the strength to support a man. Wilbur finally hit upon the solution while playing with a match box one day in the bicycle shop. He found that by a simple push pull motion the surfaces of the box could be twisted. This was exactly what he had visualized to control the wings, and they immediately set about building a small scale model along these lines.

In 1900 they decided to build a full sized glider and wrote Octave Chanute, one of the leading aeronautical pioneers of his day, asking his suggestions for a suitable testing ground. They required a place having little inclement weather and winds of at least 15 miles per hour. He suggested Kitty Hawk, North Carolina, and they accordingly established their first camp there in 1900. To them, Kitty Hawk was indeed a strange and desolate place. The difficulties they encountered were quite different from what they had expected. Orville wrote home to his sister, Katherine:

> "This is 'just before the battle,' sister, just before the squall begins. About two or three nights a week we have to crawl up at ten or eleven o'clock to hold the tent down. When one of these 45-mile nor'easters strikes us, you can depend on it, there is little sleep in our camp for the night. . . . We certainly can't complain of the place. We came down here for wind and sand, and we have got them."

Another letter home describes even more graphically their attack by a horde of mosquitoes:

> "Mr. Huffaker arrived Thursday afternoon, and with him a swarm of mosquitoes which came in a mighty cloud, almost darkening the sun. This was the beginning of the most miserable existence I had ever passed through. The agonies of typhoid fever with its attending starvation are as nothing in comparison. But there was no escape.



WILBUR WRIGHT ORVILLE WRIGHT

"PINNING"...

...A LIFETIME CAREER

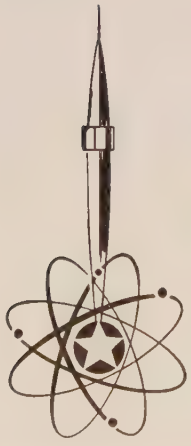
Your selection of associates is of vital importance to you. By all means every graduating engineer should investigate and consider the career opportunities offered by CONVAIR-FORT WORTH.

As a division of General Dynamics Corporation, CONVAIR engages in broadly diversified fields of development of military defense and commercial aviation. This provides interesting opportunities for every graduate with engineering and scientific talent.

Life is good in Fort Worth — where the year-around climate is conducive to outdoor living and recreation — and there are excellent schedules of athletic events, musical and theatrical presentations, ice arena, large lakes, etc. CONVAIR'S in-plant program enables candidates to earn graduate engineering degrees.

Write now for information about CONVAIR'S interest in Engineering graduates. Address

H. A. BODLEY
CONVAIR Engineering Personnel Dept.
FORT WORTH, TEXAS



CONVAIR

A DIVISION OF GENERAL DYNAMICS CORPORATION

FORT WORTH, TEXAS

An enlarged reprint of the above cut-out silhouette, suitable for framing or pinning up, will be sent free to any engineering student on request.

Four top scientists discuss creative thinking before fellow research men and engineers at a Joint Technical Conference held in French Lick, Indiana, by Standard Oil and its affiliates. Panel members were, left to right above, E. L. d'Ouville, G. W. Ritter, P. C. White, and T. A. Abbott. Moderator was Joseph K. Roberts, left inset, general manager of research and development for the parent company.

The Very Idea!

PETROLEUM scientists and engineers have a habit of coming up with the *very* idea to solve a problem at the very moment it is needed. They have created hundreds of new products and have improved others, putting the petroleum industry in the van of American industrial progress.

The contributions of Standard Oil scientists, working in extensive laboratories and with the finest equipment, have been outstanding. To give them even greater opportunity to exchange and develop ideas, Standard Oil uses the most modern techniques for stimulating creative thinking.

Groups of our scientists now meet in informal and relaxed creative sessions. Through "brainstorming" and similar devices, they contribute fresh, new thinking to the solution of specific problems. These men are creative by nature, and they "pop" even more ideas, faster, at sessions where one idea stimulates another.

In such an atmosphere of progress, young scientists and engineers find great opportunities to make positive contributions and build interesting careers.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD

The sand and grass and trees and hills and everything was fairly covered with them. They chewed us clear through our underwear and socks. Lumps began swelling up all over my body like hen's eggs. We attempted to escape by going to bed, which we did at a little after five o'clock. We put our cots out under the awnings and wrapped up in our blankets with only our noses protruding from the folds, thus exposing the least possible surface to attack. . . . The wind, which until now had been blowing over twenty miles an hour, dropped off entirely. Our blankets then became unbearable. The perspiration would roll off of us in torrents. We would partly uncover and the mosquitoes would swoop down upon us in vast multitudes. We would make a few desperate and vain slaps, and again retire behind our blankets. Misery! Misery! The half can never be told. . . ."

The glider that Wilbur and Orville constructed in 1900 was a full sized biplane capable of carrying a man on its lower wing. They had planned to soar it like a kite, but they found it did not have enough lift to fly this way. Then when they tried gliding in it with a man on the lower wing, they found their controls were not adequate. As could be expected, accidents were numerous, and repair time mounted rapidly. When the plane finally was wrecked by wind on October 10, they discovered that their actual time in the air had been only two minutes.

In 1901, Wilbur and Orville Wright made a second trip to Kitty Hawk. This time they were accompanied by two other aeronautical investigators, E. C. Huffaker and Dr. G. A. Spratt, an authority on the problems of curved surfaces. Mr. Chanute also visited them at camp that year.

Since it was necessary to build a new glider, they first erected a building to house it and to serve as quarters for them. The long frame building which they set up was open at both ends to take full advantage of the breezes and had awnings all the way around.

The glider they built was bigger and stronger than the one of the previous year. Its control was not as good, however, and this they attributed to the fact that the travel of the center of pressure toward the front edge was slower than in the machine of the previous year which had less fore-and-aft curvature. They also found that their glider did not increase in speed in free flight as the other had.

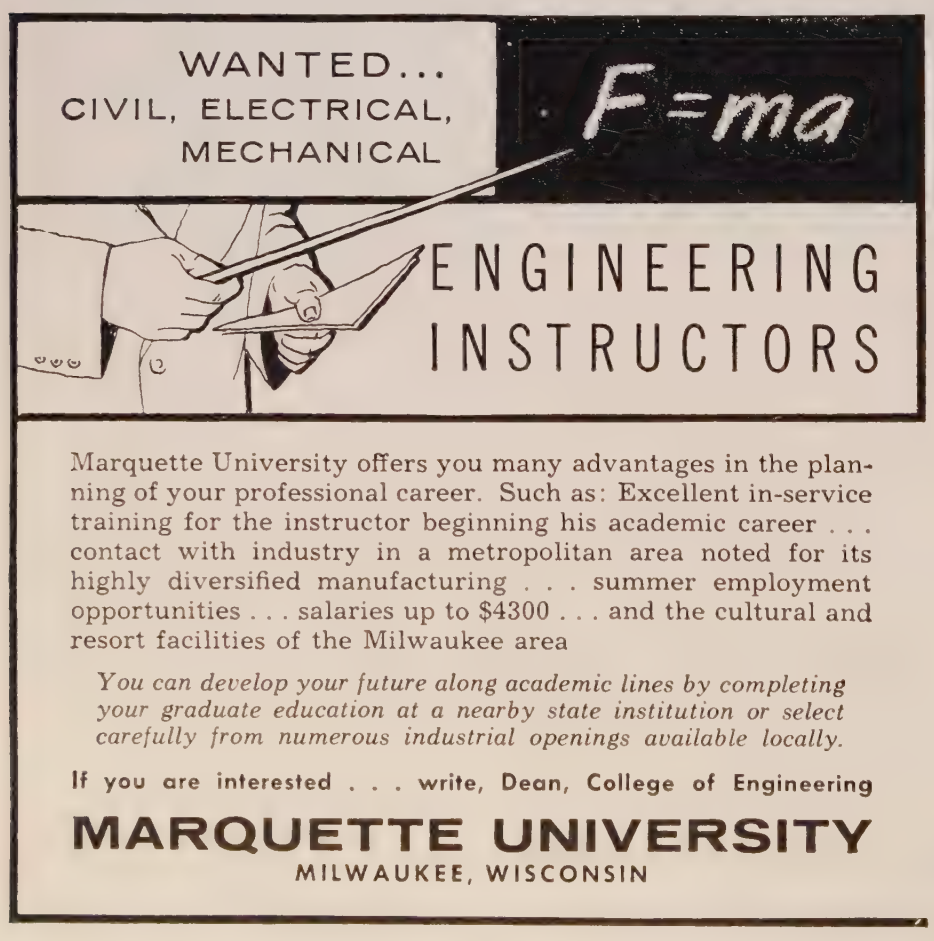
However, the machine did have its good points. For one thing, it was strong. Although it had taken some forty rough landings, it was not damaged. By the end of their stay that year they had succeeded in getting a free flight of over 300 feet, and had experimented safely with a machine of over 300 sq. ft. surface in winds as high as 18 miles per hour. It was previously thought that a glider of this size could not be flown, but although more unmanageable than the smaller glider of the year before, the Wrights had demonstrated that a large glider *was* practicable to construct and get into the air.

It might be well to note that the glides were made with the operator in a horizontal position. Early experiments were conducted with the operator changing his position up or down to control the glider. This situation had resulted in the death of Otto Lilienthal, who was caught in a sudden gust of wind, and being unable to change his position quickly enough, was dashed to the ground. Wilbur and Orville realized that this procedure would have to be changed to insure a safe flight, and they constructed a rudder which produced very good steering results. They also experimented with the shape and curve of the wings. In order to do this, they built a small wind tunnel and tested tiny model wings of all shapes in the breeze of a fan. The results were carefully noted and preserved in their wind-tunnel tables. As a result of their wind-tunnel investigations, they came to the conclusion that the wing with the least wind resistance was the teardrop shape.

The longest glide made this year (1901) was 335 feet. Wilbur Wright considered the glide of August 8 the most perfect and recorded this data in his diary:

> Speed wind, 11 miles per hr. Area 290 sq. ft.
>
> Speed of machine, *13* miles per hr. Weight 240 lbs.
>
> Relative speed, 24 miles per hr. Angle of descent 10°.

They broke camp early this year, and at the end of August returned to Dayton. In September, Wilbur Wright was invited by Octave Chanute to make an



Marquette University offers you many advantages in the planning of your professional career. Such as: Excellent in-service training for the instructor beginning his academic career . . . contact with industry in a metropolitan area noted for its highly diversified manufacturing . . . summer employment opportunities . . . salaries up to $4300 . . . and the cultural and resort facilities of the Milwaukee area

You can develop your future along academic lines by completing your graduate education at a nearby state institution or select carefully from numerous industrial openings available locally.

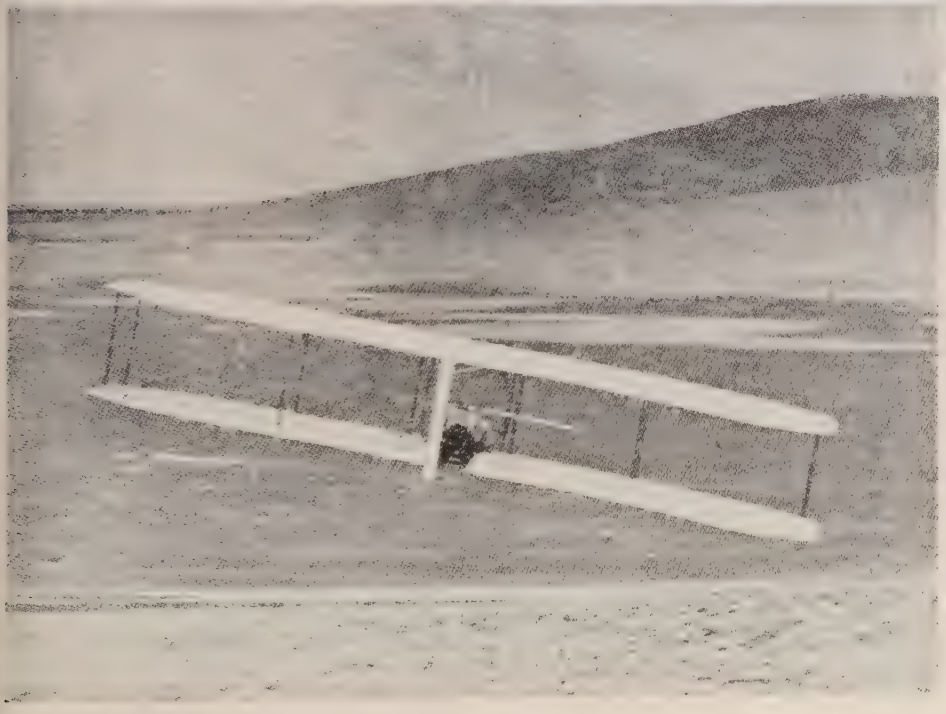
If you are interested . . . write, Dean, College of Engineering

MARQUETTE UNIVERSITY
MILWAUKEE, WISCONSIN

address to the Western Society of Civil Engineers, in Chicago. In this address he summarized the experiments made to date, and stressed the three difficulties in flying machine construction: (1) construction of the sustaining wings; (2) generation and application of the power required to drive the machine through the air; and (3) the balance and steering of the machine after it was in flight. Of these, the last problem was the most crucial, and the one the Wright brothers devoted the most time to eliminating. In theory, the balancing of a glider is simple: it consists in causing the center of pressure to coincide with the center of gravity. In actual practice, however, this is very difficult to achieve, and it was this aspect of their machine that the brothers spent the most time in experimentation.

With many of the practical problems behind them, they proceeded to build, in 1902, a machine which broke all gliding records. Now, they decided, was the time to install an engine on their plane. They wrote to several manufacturers of gasoline engines in their quest for a lightweight engine with sufficient propulsion power. Unable to locate a suitable one, they built it themselves. It was a 12 h.p. engine with aluminum casting. They also investigated propellers at this point, and learned, as they often did, that previous propeller data were not correct. They therefore set to work on the propeller problem and soon evolved a propeller, based on their own theory, which was 8⅛ feet in diameter, and which, they hoped, would prove adequate.

On September 23, they again made the trip to Kitty Hawk. Camp was set



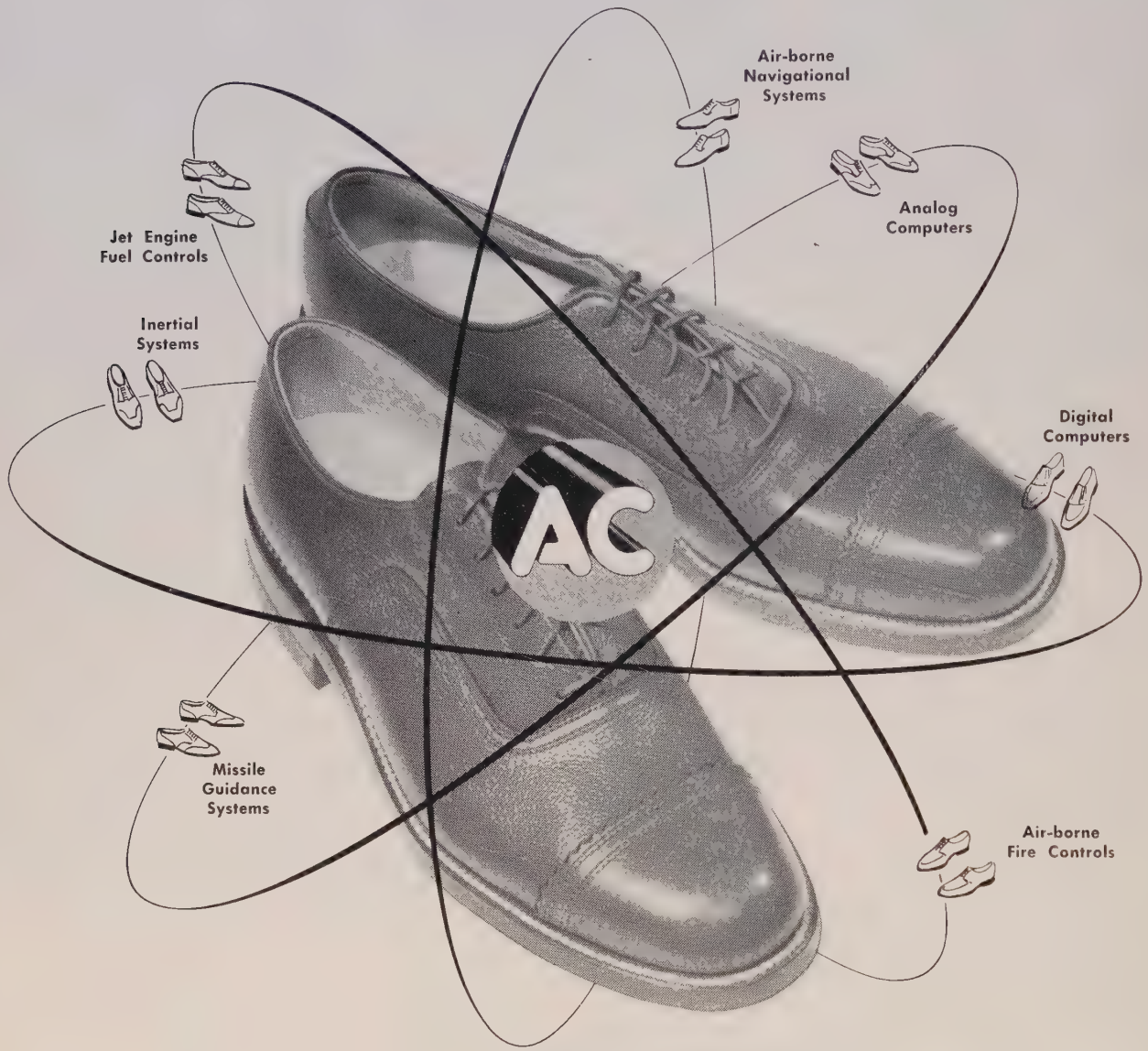
Above: Wilbur Wright gliding in the biplane—1901

Left: Wilbur Wright making right turn in glide—October 1902

Fill these shoes and there are

OPPORTUNITIES UNLIMITED

for you at AC



No job experience necessary. We will train you in the following capacities:

Mechanical Engineers. Coordination of complete product designs on precise mechanical or electro-mechanical instruments . . . computers . . . fine-pitch gearing.

Electrical Engineers. Complete systems and circuitry activities in complex electronic equipment . . . amplifiers . . . data transmission . . . servo systems . . . gyro stabilizers.

Mathematicians and Physicists. Analysis of basic problems in bombing, such as ballistics, pursuit curves and systems evaluation.

Field Engineers. Short term in plant training for immediate placement in field activities as engineering representatives for our air-borne electronic equipment.

Please send additional information on AC's Milwaukee and Flint operations.

Name_____

Address_____

_____

College_____ Degree and year_____

ADDRESS: Supervisor of Employment, AC Spark Plug Division of General Motors, Milwaukee, Wisconsin

AC SPARK PLUG

THE ELECTRONICS DIVISION OF GENERAL MOTORS

Milwaukee, Wisconsin **Flint, Michigan**

GM GENERAL MOTORS

The 1903 camp at Kill Devil Hill with the "Wright Flyer" resting alongside

up and the job of assembling the plane begun. This year they hoped for more than successful "glides"—they were ready with a gasoline powered, heavier than air machine, and it would prove whether or not all their work had been in vain. They intended to take off from a wooden rail single track, laid down in 4 sections totalling 60 feet. The cost of this track was $4.

This was in pathetic contrast to the $50,000 launching ways employed by Prof. Langley on the Potomac. While the Wright brothers were still assembling their plane, Prof. Langley launched his engine powered flying machine only to see it dive straight into the Potomac River. They were not discouraged by Prof. Langley's failure. They merely said they would wait and see what their luck would be.

It was to be a long wait. First, a storm descended on them that was so severe they were kept indoors for 4 days. When they were able to go out, they made some glides in the 1902 machine and discovered they had been reading the anemometer wrong in measuring wind speed. This meant that neither the 1902 nor the 1903 machine was as efficient as they had thought. They were obliged to get more power from the 1903 engine and propeller than they had realized, and they didn't know whether they could or not.

On November 5, the machine completed, they started up the engine. It missed explosions, shook the plane and finally the propellers were jerked out and torn to pieces. They were sent back to Dayton for repairs, and it wasn't until November 20 that they were returned.

In the meantime it was getting colder and the brothers were having a hard time keeping warm. But feeling themselves so close to victory, they were loath to leave now, with the one important fact still not known: was their machine capable of sustaining itself and a man in the air under its own power?

Several other repair jobs followed. The rollers on the runway track broke and had to be repaired. Then it rained again and forced them inside. When next they started the machine, the propellers broke again.

This time Orville went back to Dayton himself and built new shafts. The trip took 13 days. He returned on December 11.

The rudder broke. Another day was spent repairing it.

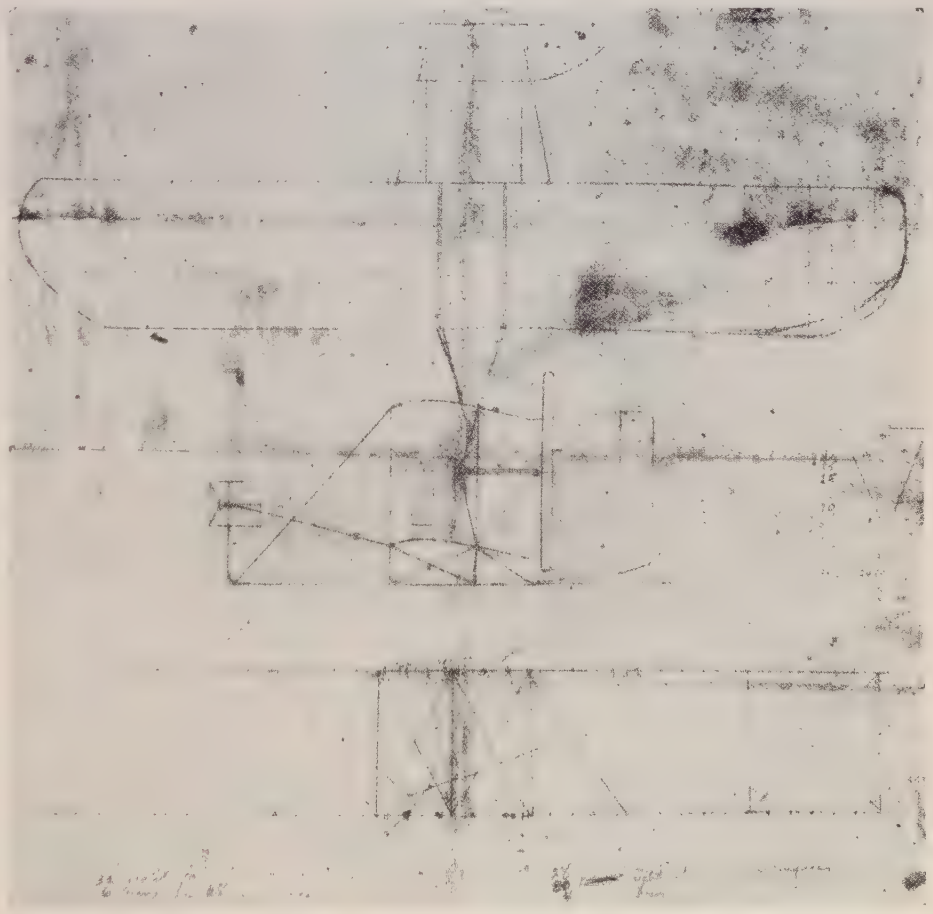
The next day the wind died down and they couldn't make the run.

Finally, on December 17, they got a wind of 20 or 25 miles per hour. They got out early and put up the signal for the men at the Lifesaving Station. The engine and propellers were run for a few minutes to see if they were all right. Orville Wright, as recorded in his diary:

> ". . . . Got on the machine at 10:35 for the first trial. . . . On slipping the rope the machine started off increasing in speed to probably 7 or 8 miles. The machine lifted from the truck just as it was entering on the fourth rail.
> ". . . . A sudden dart when out about 100 feet from the end of the tracks ended the flight. Time about 12 seconds. . . ."

Three more trials were made, the final one 852 feet in 59 seconds. On this landing the front rudder was broken, bringing the flights for that day to an end.

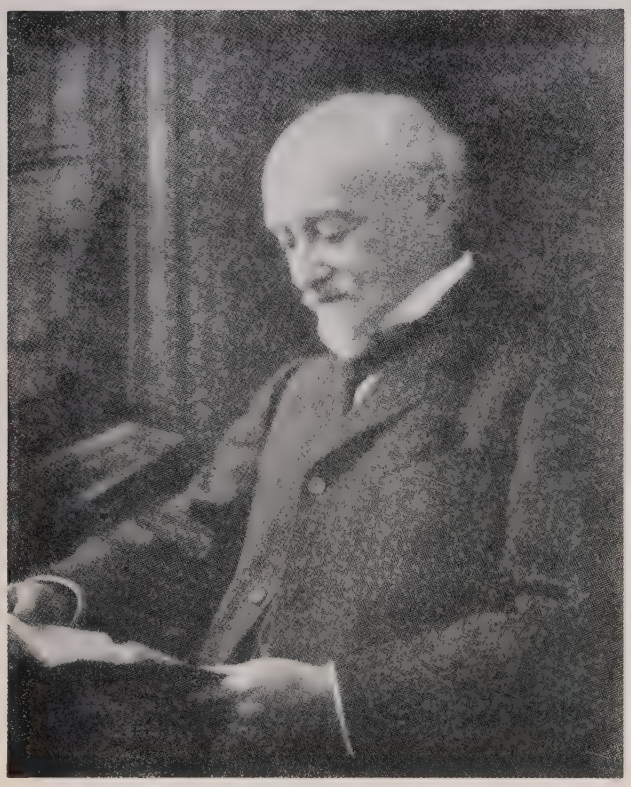
The Wright Flyer, having made hist-



Preliminary sketch of the 1903 machine. Notations are Wilbur Wright's handwriting. It was drawn in pencil on brown wrapping paper.

Early Experimentors in Flight

Lilienthal • Chanute • Langley • Ader



Octave Chanute (1832-1910), one of the leading areonautical pioneers in the United States, he was an authority on gliding. He gave invaluable assistance to the Wright Brothers in the form of advice, encouragement, and the loan of mechanical equipment. He often visited the Wright camp at Kitty Hawk to watch experiments. Chanute Air Force Base at Rantoul, Illinois, bears his name.

ory, was taken back to camp and placed near the building. Suddenly a gust of wind lifted it up and started to turn it over. The men rushed to stop it—but they were too late. The Flyer was severely damaged, and with the onset of cold weather and the approach of Christmas, the boys decided to abandon any further attempts for that year.

The telegram announcing the historic flights read as follows:

> Success four flights thursday morning all against twenty one mile wind started from level with engine power alone average speed through air thirty one miles longest 57 seconds inform Press home Christmas.
>
> Orevelle Wright

They had succeeded in a venture which they expected would yield neither recognition nor financial success—one of the last before mass research and gigantic projects all but eliminated the lone inventor.

Shortly after the boys returned home their father added this appropriate postscript to one of his letters:

> "P. S. Wilbur is 36, Orville 32, and they are as inseparable as twins. For several years they have read up on aeronautics as a physician would read his books, and they have studied, discussed, and experimented together. Natural workmen, they have invented, constructed, and operated their gliders, and finally their 'Wright Flyer,' jointly, all at their own personal expense. About equal credit is due each."

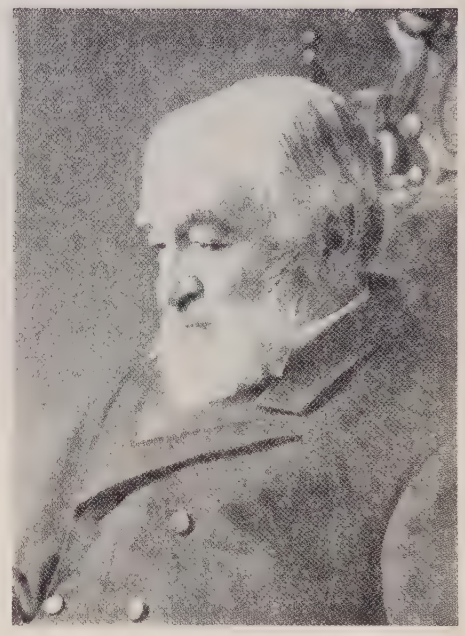
The Papers of Wilbur and Orville Wright is the story of the making of the airplane as recorded by the Wright brothers themselves. The set (Vols. 1 and II) includes approximately 1000 letters from the Wright collection and 250 from the Octave Chanute collection. Volume I, in which we are interested here, covers the six-year period of experimentation from 1899-1905. Volume II will record their later fame and public recognition.

Besides the valuable letters and diaries which record their day by day experiments, the book contains their Wind-tunnel Tables and Experiments, Propeller Notebook, Notes on Nomenclature and Chanute Documents (at the end of the book.)

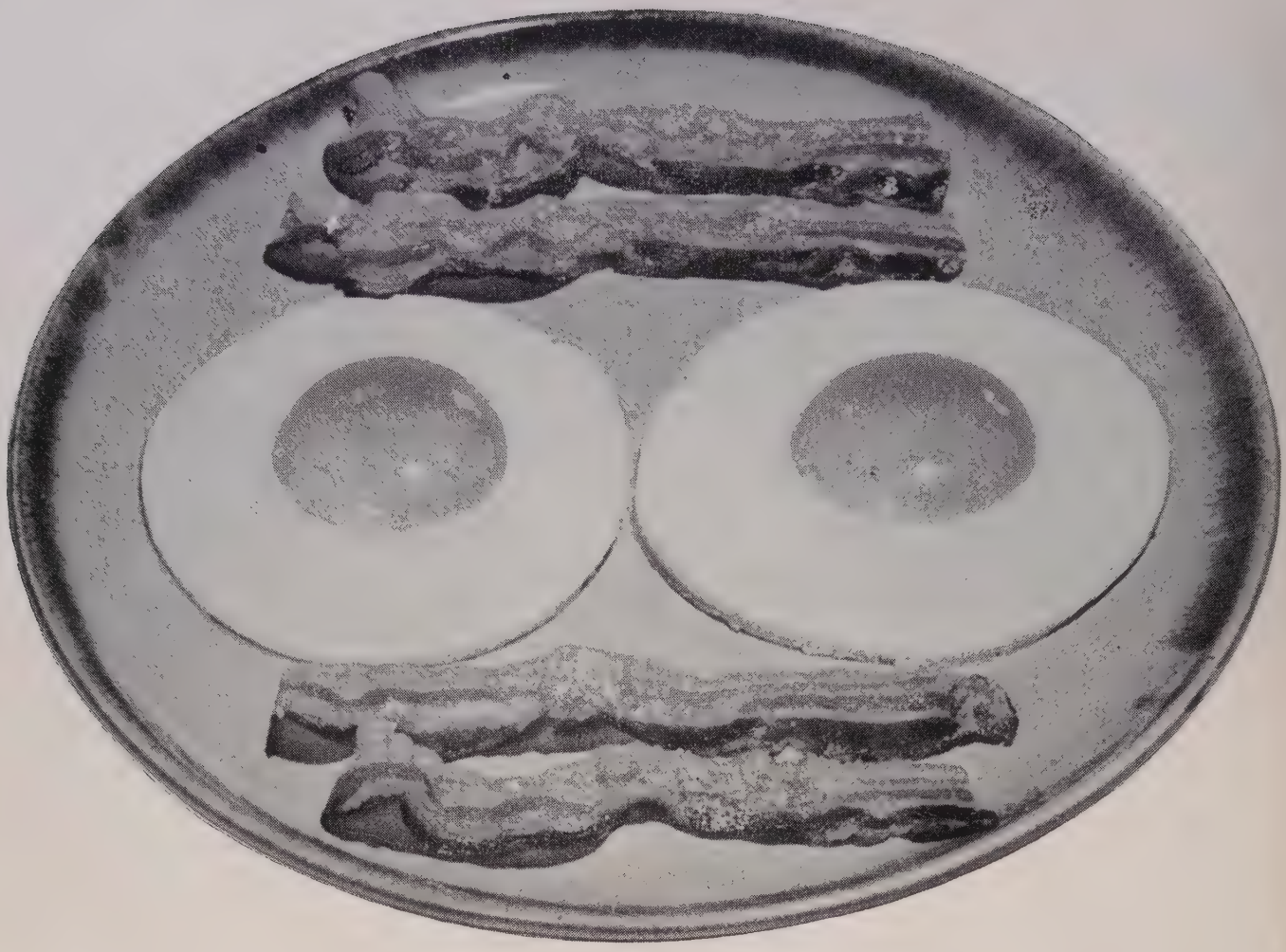
The Wright Papers were given to the Library of Congress in May, 1949, with the stipulation that they would not be available to the general public until January 1, 1960, and that in the meantime a volume such as this should be compiled and published. The work was undertaken under the sponsorship and financial assistance of Oberlin College, and required four years to complete.

Otto Lilienthal (1848-1896), German expert on gliding, whose experiments stimulated the Wright Brothers' interest in flight. He made over 2,000 successful glides. He was killed in 1896 when his glider was caught in a sudden gust of wind and dashed to the ground. On the right is shown Lilienthal's two-surface glider, in which he made some of his highest and longest glides (1895).

Samuel Pierpont Langley (1834-1906), American physicist and astronomer who became interested in aeronautics and first demonstrated that mechanical flight was possible (1896). His experimental notes were invaluable to later investigators in this field. Langley's houseboat launching apparatus on the Potomac River is pictured at left with his full-sized 1903 machine mounted. His unsuccessful attempt at powered flight preceeded by only a few days the Wright Brothers' historic flight at Kitty Hawk.



Clement Ader (1841-1925), French aeronautic experimenter. Wilbur Wright, although first considering Ader a great aeronaut, on examining his plane condemned both it and his theory as impractical. Ader's Avion No. 3 is shown with wings in folded position.

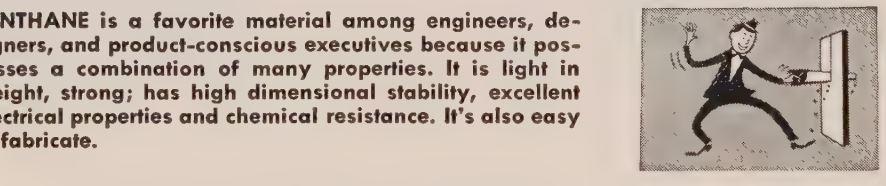


. . . a combination that's hard to beat!

Laminated plastics . . . for a combination of properties that *can't* be beat

SYNTHANE is a favorite material among engineers, designers, and product-conscious executives because it possesses a combination of many properties. It is light in weight, strong; has high dimensional stability, excellent electrical properties and chemical resistance. It's also easy to fabricate.

Synthane makes excellent ball bearing retainers. High dimensional stability, wear resistance and non-galling properties keep bearings humming smoothly at 100,000 rpm and up! Synthane's light weight minimizes the effect of any eccentricities, provides lower starting torques, less bearing weight. The Synthane plant has facilities for producing practically every type of laminated plastic retainer known.



EASILY MACHINED

DIELECTRIC STRENGTH

TENSILE STRENGTH

CHEMICAL RESISTANCE

Property combinations! Synthane has them . . . in over 30 individual grades . . . sheets, rods, tubes, moldings and completely fabricated parts. Send for free illustrated catalog today.

SYNTHANE

SYNTHANE CORPORATION, 13 RIVER ROAD, OAKS, PA.

CONSTRUCTION— Tremendous rotary kilns, like these, typify Allis-Chalmers role in the cement industry.

Join the company that serves 3 GROWTH INDUSTRIES

Match your engineering talents to the future needs of the construction, power and manufacturing industries. These are growing needs—for the population is climbing at the amazing rate of 50,000 people every *week!*

Many billions of dollars for highway *construction* alone are called for by the President in the next ten years. Allis-Chalmers builds equipment used in making cement, aggregate and steel as well as earth movers and graders.

Electric *power generation* will double in ten years. A-C builds the machines that make electricity.

Manufacturing output must increase $3.5 billion by this time next year. Allis-Chalmers builds motors, control, drives and many other types of equipment for this industry.

Here's what Allis-Chalmers offers to Young Engineers:

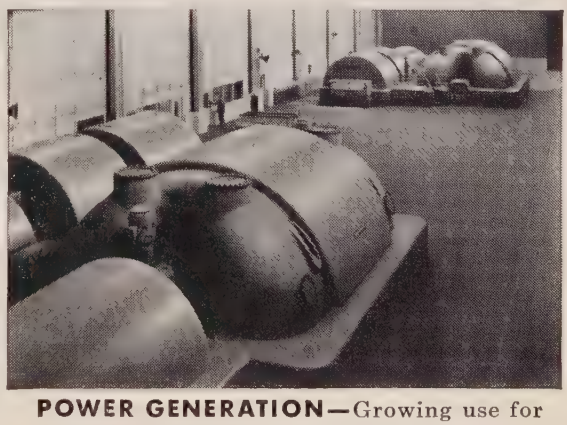
A graduate training course that has been a model for industry since 1904. You have access to many fields of engineering: electric power, hydraulics, atomic energy, ore processing.

There are many *kinds* of work to try: Design engineering, application, research, manufacturing, sales. Over 90 training stations are available, with expert guidance when you want it. Your future is as big as your ability can make it.

Or, if you have decided your field of interest and are well qualified, opportunities exist for direct assignments on our engineering staff.

In any case—learn more about Allis-Chalmers. Ask the A-C manager in your territory, or write direct to Allis-Chalmers, Graduate Training Section, Milwaukee 1, Wisconsin.

MANUFACTURING—A-C aids high speed production and helps improve quality with dielectric sand core dryers like the one above.



POWER GENERATION—Growing use for power means growing demand for A-C steam turbines, transformers, and other equipment.

ALLIS-CHALMERS

A-4685

BRAIN TEASERS

by Larry Kiefling, M.E. '56

1. What is today, if, when the day after tomorrow is yesterday, today will be as far from Tuesday as today was from Tuesday when the day before yesterday was tomorrow?

2. What is the smallest number in which the digits are reversed when 2 is added to its double?

3. Try to find the area between two circles of radius ten inches each, with centers ten inches apart.

4. Here's a joker who's positive he's revolutionized arithmetic; what's wrong with his proof that $1 = 2$?

$$1 - 3 = 4 - 6$$
$$1 - 3 + 9/4 = 4 - 6 + 9/4$$
$$(1 - 3/2)^2 = (2 - 3/2)^2$$
$$1 - 3/2 = 2 - 3/2$$
$$1 = 2$$

5. How would you measure the height of the Leaning Tower of Pisa with a barometer and a stopwatch?

6. A checkerboard has two squares in diagonally opposite corners removed. You have 31 dominos which each can cover two squares and you are asked to place them upon the remaining 62 squares on the checkerboard so that each square is covered with half a domino. The dominos are unfortunately uncuttable.

After trying this task, and I suggest you do so on paper, you will find it quite impossible. Now here is the question: Why is it impossible?

Warning: The answer, although elusive, is very simple, so if you want to be able to live with yourself, give it a good try.

7. Two clocks both indicate the true time today at noon. The first gains a second an hour, the second loses 3 seconds in 2 hours. When next will they both indicate the same time, and when next will they both indicate the true time?

8. An engineering student was going hunting in Canada, wished to take his gun with him on the train. The ticket agent told him he could not take the gun with him in the coach, while the baggage man would not take it because of its excessive length (1.7 yards), since he was forbidden to accept for shipment any article whose greatest dimension exceeds 1 yard. How was he able to take the gun on the train with him?

9. There was a young and adventurous fellow whose great-grandad left him nothing much but the logs from the old salt's searfaring days. The young fellow never quite got up courage enough to toss the books out, and one day was leafing idly through them. Stuck between two pages he found a much-folded paper which read as follows:

"Sail to 16 North latitude and 16 West longitude where thou wilt find a deserted island. There lieth a large meadow, not pent, on the north shore of the island where standeth a lonely oak and a lonely pine. There wilt thou also see and old gallows on which we once were wont to hang traitors. Start thou from the gallows and walk to the oak counting thy steps. At the oak thou must turn right by a right angle and take the same number of steps. Put here a spike in the ground. Now must thou return to the gallows and walk to the pine counting thy steps. At the pine thou must turn left by a right angle and see that thou takest the same number of steps, and put another spike into the ground. Dig half-way between the spikes; the treasure is there."

The instructions were quite clear and explicit, so our boy chartered a ship and sailed to the South Seas. He found the island, the field, the oak, the pine: indeed, he found everything he was looking for but the gallows. Rain, sun, and wind had long since taken away all trace of the wooden structure. How did our hero find the treasure?

10. Shuffle an ordinary bridge deck and turn the cards face up in pairs. If both cards are black, you get them, but if they are red, I get them. In the event that one is black and the other red, they are discarded and belong to neither of us.

You will be charged one dollar for the privilege of playing the game, but when the deck is depleted I will pay three dollars for every card more than I which you have. If you have less than I, you are not charged.

What is the probability that you will come out of this game financially ahead?

11. By one straight cut a storekeeper cut a 5 pound segment off a circular disk of cheese. The curved part of the segment was ¼ of the circumference of the disk. What did the whole cheese weigh?

12. A suit of 13 cards, the ace, king, queen, jack, 10 . . ., 2 of spades, is arranged in a certain order. The first card is taken off the pack, the second is put at the bottom, the third is taken off, the fourth is put at the bottom, and so on. What was the original order if the order in which the cards were taken off was ace, king, queen, jack, 10 . . ., 2?

SOLUTIONS

1. Today is Tuesday.

2. 25; $(2 \times 25) + 2 = 52$.

3. The area in the overlapping parts of those two ten-inch-radius circles is 22.84 square inches. The area is the sum of two equilateral triangles and four segments.

4. After the square root is taken, the correct answer is:

$$\pm (1 - 3/2) = \pm (2 - 3/2)$$

5. Drop the barometer and time its fall with the stopwatch, using the formula $h = \frac{1}{2}gt^2$ to calculate the height.

6. Each time a domino is placed down, a light square and a dark square are covered. Since the opposite squares which were removed are always of the same color, an unequal number of light and dark squares remain. Need more be said?

7. Same time in 720 days; true time in 3,600 days.

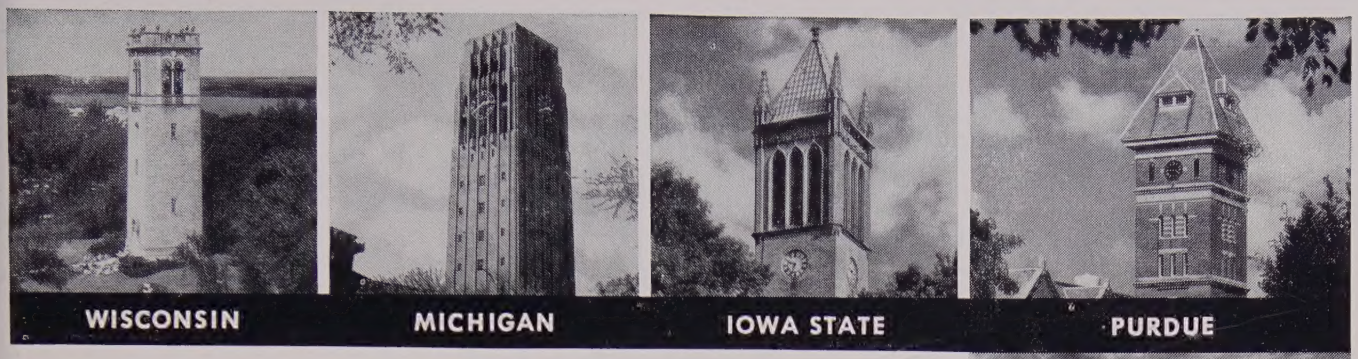
8. Pack the gun in a cubic case of 1 yard per side.

9. Our adventurous treasure-seeker located his treasure because it did not matter where the gallows was located. The spot where the treasure was buried lies equi-distant from two trees mentioned and one-half of the distance to the left of the point where the equidistant line and the line connecting the trees intersect.

10. ½.

11. 55.038 lbs.

12. A, 3, K, 7, K, 4, J, 6, 10, 2, 9, 5, 8.

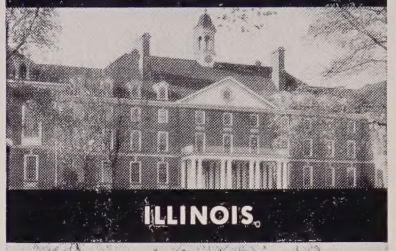


Where do you go from here?

Year after year, we draw on these nine schools for electrical, mechanical, industrial and general engineers.

If you are looking for a future with real opportunities for growth and advancement, Square D has a lot to offer. The potential growth and development of the electrical industry is tremendous—doubling every ten years, in fact. And Square D is a long established, top ranking name in that expanding industry. Equally important, Square D offers the kind of personalized training that equips you to go far . . . *fast!*

Why not let us tell you more about Square D and what we have to offer?



Mail the Coupon

We'd like to send you a brochure, "Your Engineering Career." It gives the simple rules to follow in selecting an engineering career.

Square D Company, Dept. SA
6060 Rivard Street, Detroit 11, Michigan
I'd like a copy of Square D's brochure, "Your Engineering Career"

Name_____

School_____ Class_____

Address_____

City_____ Zone____ State_____

SQUARE D COMPANY

Twenty-Third Psalm to an Engineer's Sweetheart

VERILY I say unto you, marry not an engineer, for the engineer is a strange being and possessed of many devils.

Yea, he speaketh eternally in parables which he calleth formulae.

And he wieldeth a big stick which he calleth a slide rule and he hath but one Bible —a handbook.

He talketh always of stresses and strains and without end of thermodynamics.

He showeth always a serious aspect and seemeth not to know how to smile.

And he picketh his seat in the car by the springs thereof and not by the damsel beside him.

Neither doth he know a waterfall except by its power, nor a damsel, except by her specific heat.

Always he carrieth his books with him and he entertaineth his maiden with steam tables.

Verily though she expecteth chocolates when he calleth, she opens the package to disclose samples of iron ore.

Yet, though he holdeth his damsel's hand but only to measure the friction, and he kisses only to test the viscosity.

For in his eyes shineth a faraway look which is neither love nor longing, but a vain attempt to recall a formula.

There is but one key dear to his heart, and that is a Tau Beta Pi key, and one love letter for which he yearneth, a "C,"

And when to his damsel he writeth of love and signeth with x's, mistake not these symbols for kisses, but for unknown quantities.

When a boy he pulleth a girl's hair to test the elasticity, but as a man he discovers different devices,

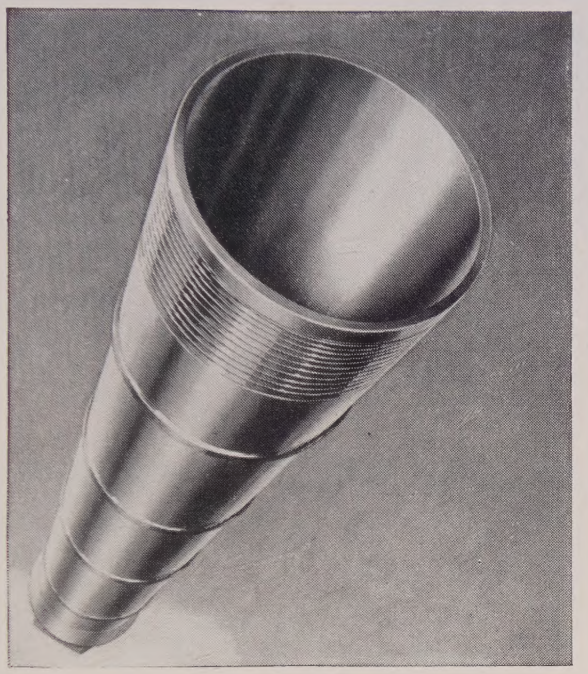
For he would count the vibrations of her heart beat and he reckoneth her strength of materials.

For he seeketh ever to pursue the scientific investigation, even his heart flutterings he counteth as a vision of beauty and he inscribeth his passions in a formula.

And his marriage is a simultaneous equation, involving two unknowns and yielding diverse answers.

Another page for **YOUR STEEL NOTEBOOK**

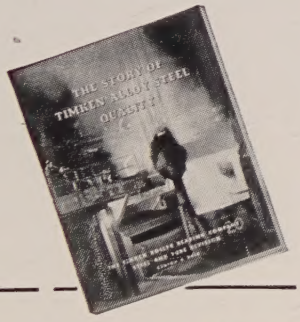
The bomb that's built not to explode



This cylinder is called an accumulator. It's used in aircraft to store hydraulic pressure, principally for raising and lowering landing gear and wing flaps. Its working pressure amounts to 3,000 pounds per square inch—so great that faulty material or construction would cause the accumulator to burst with the deadly power of a bomb. The manufacturer was having trouble with variations in the strength and quality of the steel being used. Defects showed up after machining. Rejects were running at a high rate.

The manufacturer called in metallurgists of the Timken Company for help in solving the problem. They recommended a certain analysis of Timken fine alloy seamless steel tubing, specially heat-treated for this application. Result: since switching to Timken fine alloy steel, the Company reports each accumulator can be tested safely at 6,000 pounds per square inch—twice its working capacity—and that rejects are now a rarity.

Want to learn more about steel or job opportunities?

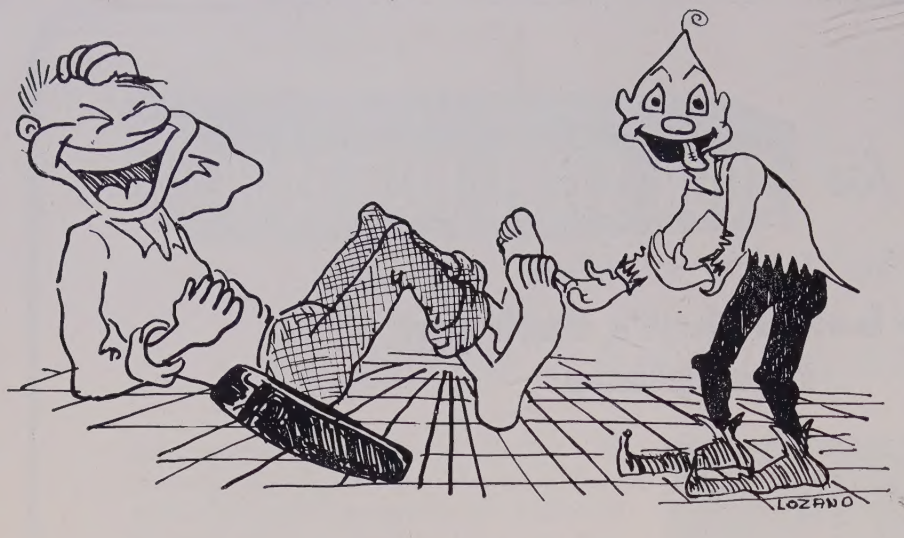


Some of the engineering problems you'll face after graduation will involve steel applications. For help in learning more about steel, write for your free copy of "The Story of Timken Alloy Steel Quality." And for more information about the excellent job opportunities at the Timken Company, send for a copy of "This is Timken." Address: The Timken Roller Bearing Company, Canton 6, Ohio.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

TIMKEN
TRADE-MARK REG. U.S. PAT. OFF.
Fine Alloy
STEEL

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING



TECHNOCRACKS

"Of course you're the first girl I ever kissed," said the Senior M. E. as he shifted gears with his foot.

* * *

A woman approached the pearly gates and spoke to St. Peter.

"Do you know if my husband is here? His name is Jones."

"Lady, we have lots of them here. You'll have to be more specific."

"Joe Jones."

"Lotsa those, too. You'll have to have more specifications."

"Well, when he died he said that if I were untrue to him, he'd turn over in his grave."

"Oh, you mean 'Pinwheel Jones.' "

* * *

I serve a purpose in this school
On which no man can frown
I quietly sit in every class
And keep the average down.

* * *

I'll see you," said our hero as he laid down a royal flush in a game of strip poker.

* * *

A college student arrived at the Pearly Gates where St. Peter asked him who he was. When told he was a L.A. student, St. Peter said, "Go to the Devil." Some time later an ag student arrived, and upon being asked who he was, replied that he was an ag student; He was told to go to Hades. The third student arrived at the Pearly Gates with his slide rule. When he was asked who he was, he replied, "I'm an engineer." Where upon St. Peter said, "Come in, son, you've been through Hell already."

* * *

C. E.: "Did Fifi blush when the strap on her bathing suit broke?"

Chem. E.: "I didn't notice."

Gas station attendant (pointing to choke lever): "You say your car uses too much gas? Know what this is for?"

Woman (airily): "Oh, that! I never use it, so I keep it pulled out to hang my handbag on."

* * *

Hattie: "This sweater fits perfectly —I'll take the next smaller size."

* * *

Then there was the man who tried every method he knew to rid his lawn of dandelions. In desperation, he wrote to our Ag department, listing all the remedies he had tried, and appealing, "What shall I do now?"

He promptly received this answer: "Suggest you learn to love them."

* * *

A young man had to rush his wife to the hospital in a terrible hurry. The race was swift, and the occasion dramatic, but they didn't quite make it. The baby was born on the lawn outside the hospital.

In time, a bill came and among the items was one which read: Delivery room, $35.00."

The new father indignantly returned the bill, pointed out the injustice and demanded an adjustment.

The bill came back promptly and the father was astonished to read the following revision of the disputed item: "Greens fee, $35.00."

* * *

Lack of something to feel important about is almost the greatest tragedy a man can have.

* * *

I eat my peas with honey—I've done it all my life. It does make the peas tast funny—but it keeps them on my knife.

The mayor of Manhattan states that the new liquor laws must be enforced. He said a city ordinance states that no liquor store shall be nearer than 300 feet from a church. He is giving them three days to move the church.

* * *

A professor is a man whose job is is to tell students how to solve the problems of life which he himself has tried to avoid by becoming a professor.

* * *

The little fellow sat up in his nursery crib and called to the baby in the adjoining crib: "Did you throw water into my crib?"

"Not me."

"Hmm—must have been an inside job."

* * *

"Yes, this is a nice little apartment but where is the bath?"

"Oh pardon me! I thought you were one of those engineering students who wants the place just for the winter."

* * *

Fraternity Brother: "Did you know that we maintain seven homes for the feeble-minded?"

Pledge: "I though you had more chapters than that."

* * *

The lads at the corner drug store were exchanging stories about their experiences with the opposite sex.

"Aw," sniffed one, "girls are a dime a dozen."

"Gee," sighed the younger lad, who had remained silent until now, "and all this time I've been buying jelly beans!"

* * *

Many engineers think a good time is going places and undoing things.

* * *

Sweet Young Thing: I hit a telephone pole last night.

Second Same: It's a wonder you neck wasn't broken.

S.Y.T.: Well, it wasn't broken, but it was sadly interrupted.

* * *

And then there is the farmer who was looking for the needle in a haystack because that's where his daughter did all her fancy work.

* * *

Pablo Piasco, a modernistic painter was robbed. In order to assist the police he drew a sketch of the villain. Guided entirely by the sketch, the police promptly rounded up two people, a TV aerial, three can openers, a hearse, and two pairs of old boots.

* * *

She was a Honey Chile in New Orleans,
The hot spot of the bunch.
But on the old expense account,
She's gas, cigars, and lunch.